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We Are What We See? – Aggression and Neurological Activation Towards Affective Imagery

WE ARE WHAT WE SEE? – AGGRESSION AND NEUROLOGICAL ACTIVATION TOWARDS AFFECTIVE IMAGERY

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Abstract

Violent and erotic media has been suggested to have a long-lasting negative effect on both the brain and behaviour (e.g. Anderson & Bushman, 2001; Grimes, Anderson & Bergen, 2008) and has been linked with increased aggression (Anderson & Bushman, 2001, 2002; Bartholow, Bushman, & Sestir, 2006; Engelhardt, Bartholow, & Saults, 2011; Greitemeyer, 2018). This thesis is the first comprehensive investigation into the effects of aggression and visual media content on early neurological response. Despite adopting gold-standard measures of aggression and contemporary EEG methodology, there was no evidence to support claims of a negative effect using a range of differing content visual stimuli. However, participant sex was identified as a key defining factor in electrocortical response towards all stimuli categories. In general, females tended to respond with an early negativity bias and an increased overall response in comparison to males. This was especially found where the content was related to biological drives. Support was found for research and theory providing that attention is motivated towards evolutionary salient stimuli (e.g. Gur et al, 2002; Kim et al. 2013; Schupp, Junghofer, Weike and Hamm, 2003; Weinberg and Hajak, 2010; Wheaton et al, 2013), and preferred media content (Boheart, 2001; Nordstrom and Wiens, 2012). A variety of measures of aggression have been employed within the field with inconsistencies across procedure, analysis method and reporting that has impacted objectivity and the validity of findings. Four methods of data processing were employed in order to analyze scores on trait aggression scales. Results showed that trait aggression appeared to modulate ERP response towards affective imagery. However, this finding was sex specific (for males only) and was dependent on data processing method employed thus, was inconsistent. This identified that minor modifications to simple data processing techniques have major implications on results and meaning. These findings have clearly demonstrated the need for standardization of methods and analysis across processes, measurement tools and techniques. Additional investigation found that there were numerous elements of stimuli content and context that influenced response. This included neutral stimuli. Taken together, these findings have made a clear case for the requirement of a valid stimuli collection that encompasses a stringent classification of appropriate content that can be widely adopted across research within multiple disciplines.

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List of abbreviations

CMoA	Catalyst Model of Aggression (Ferguson, 2007)
DM	Disgust(ing) Media
EEG	Electroencephlographic Method
EM	Erotic Media
ERP	Event Related Potential
GAM	General Aggression Model (Anderson and Bushman, 2002)
HAF	High Aggression Females
HAM	High Aggression Males
IEM	Indirect Effects Model (Malamuth and Briere, 1986)
LAF	Low Aggression Females
LAM	Low Aggression Males
NVVG	Non-Violent Videogames
VM	Violent Media
VVG	Violent Videogames

Chapter 1 **Introduction**

Intensive academic debate has reverberated public interest and concern over the true effects of the media on the brain and behaviour (Chadee, Smith, & Ferguson, 2017; Ferguson, Rueda, et al., 2008; Ferguson, San Miguel, Garza, & Jerabeck, 2012; Grimes, Anderson, & Bergen, 2008). Research has suggested that media has both detrimental (Anderson & Bushman, 2001; Engelhardt, Bartholow, Kerr, & Bushman, 2011; Huesmann, 2010; Malamuth, 1986; Malamuth, Addison, & Koss, 2000; Malamuth, Hald, & Koss, 2012) and positive effects (Gitter, Ewell, Guadagno, Stillman, & Baumeister, 2013; Greitemeyer & Mugge, 2014; Liu, Teng, Lan, Zhang, & Yao, 2015).

The mass media is one of the largest grossing industries worldwide (Statista, 2017a) with global entertainment and media boasting a projected £2.2 trillion worth by 2021 (Statista, 2017b). The revenue for the global film industry alone has been predicted to rise from $38 billion in 2016, to approximately $50 billion in 2020. The adult film industry has a net worth of $97 billion and an annual revenue of $13.3 billion (StatisticBrain, 2016) and produces over 11,000 new titles, per year (HBAT, 2016). These figures do not include the adult media on social media sites or freely available on the internet, where approximately 12% of content is pornographic (HBAT, 2016) and where an estimated 50% of all traffic is sex related (Kuhn & Gallinat, 2014). The largest adult site reported that during 2016, nearly 4.6 billion hours of pornographic material had been watched by its 23 billion visitors (FightTheNewDrug.org, 2017).

In addition, the global videogame market has seen expediential exponential year on year growth. Revenue is expected to rise by 27% from $101.1 billion (2016) to $128.5 billion in 2020 (Ukie, 2017). That could be considered a relatively low target with sales of Rockstar's Grand Theft Auto reaching $1billion worldwide in just 3 days, selling over 6 million copies and becoming the top selling game of all time in the UK (Ukie, 2017). Considering that the total UK population was calculated at 65.6 million in 2016 (BBC, 2017; ONS, 2017b), this has suggested that approximately 10% of the UK population has bought the game.

It has been proposed that UK adults spend an average of eight hours and 41 minutes per day consumed on media devices and approximately 4 hours per day watching television (Miller, 2014) . This demonstrates that UK adults spend longer, on average, using technology and main stream entertainment devices than they receive on an average night's sleep (Miller, 2014). Additionally, research has shown media exposure activates brain areas linked with craving in addiction (narcotics and pathologic gambling) potentially illustrating the need to continue being 'plugged in' (Fletcher-Watson, Findlay, Leekam, & Benson, 2008; D. H. Han et al., 2011). Based on the facts and statistics provided, it is clear to see that the media plays an entangled and integral part of society.

A plethora of research has suggested that there was a direct causal link between exposure to violent media (VM) and increased aggression (Anderson & Bushman, 2001, 2002; Anderson, Carnagey, & Eubanks, 2003; Bartholow, Bushman, & Sestir, 2006; Boxer, Huesmann, Bushman, O'Brien, & Moceri, 2009; Carnagey, Anderson, & Bushman, 2007; Dill, Brown, & Collins, 2008; Engelhardt, Bartholow, Kerr, et al., 2011; Engelhardt, Bartholow, & Saults, 2011; Huesmann, 2010; Krahé & Möller, 2010; Krahe et al., 2011). Similarly, associations between exposure to erotic media (EM) and an increase in sexual aggression and negative attitudes towards women has been acknowledged (Beck, Boys, Rose, & Beck, 2012; Donnerstein & Linz, 1986; Hald & Malamuth, 2015; Linz & Donnerstein, 1988; Malamuth, 1986; Malamuth et al., 2000; Malamuth, Heavy, & Linz, 1996; Scott & Schwalm, 1988). However, much of the research has been criticised for a lack of systematic, valid and empirical examination conducted within a field that has been shrouded by publication bias and an aversion towards reporting the null which has potentially impacted the discovery of the true relationship between the media and the human brain and behaviour (Ferguson, 2007a, 2007b; Ferguson & Dyck, 2012; Ferguson, Garza, Jerabeck, Ramos, & Galindo, 2013; Ferguson & Kilburn, 2010; Ferguson, Smith, Miller-Stratton, Fritz, & Heinrich, 2008; Griffiths, 1999; Heene & Ferguson, 2017; Jerabeck & Ferguson, 2013; Ward, 2011).

1.1 Aggression Definition, Types & Prevalence

In order to understand the multifarious nature of aggression and the potential contributory causes, it is important to consider its definition. Leading contemporary definitions state that aggression can be classified as motivated behaviour conducted against another, oneself or objects with the proximate intent to cause psychological or physical harm (Anderson & Huesmann, 2003; Baron & Richardson, 1994). In addition, the perpetrator must understand, and be able to predict, that the behaviour committed can cause harm and if the target is another individual, that individual must be motivated to avoid such behaviour (Anderson & Bushman, 2002; Berkowitz, 1993). However, there has been disagreement regarding a single, allencompassing definition (Anderson & Bushman, 2002; Ramirez & Andreeu, 2006) with difficulty arising due to the multifaceted and potentially philosophical concept of aggression (Ramirez, 2009). It should be acknowledged that terminology such as "violence", "anger" and "aggression" have been used interchangeably within the literature although, there are marked differences between the three (Bernstein & Gesn, 1997; Bushman, 2016). Each can be internalised and felt or, externalised and demonstrated in isolation. For example, aggression can exist without violence (e.g. verbal attacks) and violent behaviour can exist without anger (sport violence or self-defense) (Warburton & Anderson, 2015). Thus, the complex and multi-layered phenomenon of aggression has been approached in a number of different ways with a myriad of classification, explanations and distinctions (see Ramirez, 2009 for brief overview).

Although aggression can manifest in a variety of ways (e.g. shouting, swearing, threatening others verbally and/ or positioning the body in aggressive ways, carrying out abusive phone calls, emotionally abuse, maternal aggression, physical interpersonal violence and sexually manipulative or sexually violent acts (Baron & Richardson, 1994; Bushman, 2016; Shaw, 1999)), often the complexity of the phenomena has been discussed using various dichotomous subtypes (for example, but not limited to, direct versus indirect; active versus passive; hostile verses instrumental (Buss, 1961; Krahé, 2013)). Some have focused on the motivation for the aggressive behaviour e.g. reactive/ instrumental, (Baron and Richardson, 1994), whereas for others, focus has been on potential manifestation (e.g. overt/covert; Bendig, 1962; Berkowitz, 1993; Verona, Reed, Curtin, Pole, 2007). Despite the last 60 years of debate and theorizing, there has yet to be any parsimonious categorisation of human aggression (Allen, Anderson, & Bushman, 2018; Bushman, 2016; Ramirez, 2009; Ramirez & Andreeu, 2006).

Most of the subtypes of aggression have considered the distinguishing heterogeneous features as belonging to either that which could be considered as self-preserving, or to behaviours with inhumane intent. Buss (1961) divided aggressive behaviours into two types; hostile and instrumental aggression. Hostile aggression was depicted as aggression aimed only at hurting another and instrumental aggression referred to aggression potentially viewed as appropriate and with an element of reasoning (e.g. in self-defense circumstances) (Buss, 1961). Subsequent researchers have suggested that the distinction should be made between whether the aggression has a premeditated element (e.g. Anderson and Carnagey, 2004). Thus, recently two categories; Affective and Predatory aggression were identified (Bushman, 2016). In this context, affective aggression is similar to that categorised by Buss (1961) however, it includes any type of unplanned behaviour that is elicited due to a sense of fear. In contrast, predatory aggression is aggression that has had forethought therefore is planned and premeditated (Anderson & Carnagey, 2004; Bushman, 2016; Warburton & Anderson, 2015).

Irrespective of aggressive type or category, it is imperative that aggressive behaviour is put into perspective. Deliberate, lethal interpersonal aggressive acts have been documented from the Ionian stage (Middle Pleistocene - from 1.806 million (±5,000 years) to 11,550 years before present) and has continued to plague societies worldwide (Lourens, Hilgen, Shackleton, & Laskar, 2004; Sala et al., 2015). From an evolutionary perspective, it has been surmised that aggressive acts, both interpersonal and interspecies, have protected the longevity of the homosapien races across time (e.g. the Darwinian perspective of the 'survival of the fittest'). Successful traits that enable further genetic distribution and removal of possible threats have been preserved (Duntley & Shackelford, 2008; Sala et al., 2015). Therefore, aggression is not a new phenomenon however, the adaptive nature of aggression has recently been considered maladaptive due to changes in socioeconomic and cultural development (DeWall & Anderson, 2011).

In the UK between 1995 and 2013, police recorded crime rates (National Crime Recording Standard (NCRS)) showed a decreasing trend for violent crimes (Office for National Statistics (ONS), 2017). However, statistics extracted from the ONS (2017a) illustrated that there were 778,870 interpersonal violent acts as recorded by the police in the year ending March 2015 with 48% of these including an injury and homicide accounted for 0.1% (537) of the total. This rate was the first increase in recorded violent crime since 2005. Notably, police recorded crime rates had shown an increase of 12% in sexual offences in 2016 in comparison to the rates of 2015. However, the Crime Survey for England and Wales (CSEW) provided estimated numbers of victims of intimate violence (aged 16-59) for the year ending March 2016 and found no significant change (2.0%, equivalent to 645,000 victims) from the previous year (ONS, 2017a). The spikes in trends have been attributed to an increased victim willingness to come forward and more vigilant record keeping (ONS, 2017a, 2017c; Walby, Towers, & Francis, 2016). Therefore, there appears to have been no significant increase in violent crimes that could coincide with the expanse of media platforms and the entangled use of those platforms within society. Although, it could be argued that historical forms of media (e.g. poetry, plays, Roman Games and Jousting) had harmful effects prior to the current platforms (see Ferguson, 2010) therefore, any increase would be minimal.

Most concerningly, advancements in technology (e.g. weaponry efficiency) have created a podium for violence and aggression to have a wide-reaching effect. For example, school shootings (e.g. Harris and Klebold who murdered 13 people and wounded 23 in Littleton, Colorado on the 20th April, 1999), mass shootings (Paddock who murdered 54 people and injured 241 in Nevada, Las Vegas on the 1st of October, 2017), suicide bombings (Abedi who killed 22 people and injured 116 in Manchester, UK on the 22nd May, 2017) and the use of commercial aircraft as weapons flown into the World Trade Centre towers in September, 2001, that killed nearly 3000 people and injured in excess of 6000. It can therefore be considered imperative that research maximises understanding potential triggers of such behaviours for an opportunity to reduce any future negative effect. Owing to the growing support for research suggesting that the impact of mass media exposure is detrimental and causal of concern (e.g. Anderson and Bushman, 2002: Dewall, Anderson and Bushman, 2011) it has warranted additional close examination.

1.2 **The Cognitive Measurement of Aggression**

Researchers have been trying to identify a valid measure of aggression for decades (Elson, Mohseni, Breuer, Scharkow, & Quandt, 2014; Walters & Zaks, 1959). However, it has been difficult to accurately categorise and measure due to multifaceted nature of aggression (see Ramirez, 2009) and the human necessity for a positive self-presentation. Since human aggression has been viewed as unethical with potentially detrimental consequences (Denson, Pedersen, Friese, Hahm, & Roberts, 2011), the social impact of disclosing true aggressive thoughts or behaviour could be self-damaging therefore, people tend towards reviewing themselves in a positive, socially desirable manor (Vigil-Colet, Ruiz-Pamies, Anguiano-Carrasco, & Lorenzo-Seva, 2012), thus the truth can be, purposefully or otherwise, inaccurately reported (e.g., James, McIntyre, Glisson, Green, Patton, LeBreton, et al., 2005).

In an attempt to reduce this social desirability response bias (Anguiano-Carrasco, Vigil-Colet, & Ferrando, 2013) and the associated complications (e.g. magnification or diminishment of true effects, participant transparency), researchers have developed multiple techniques and methods for assessing both state and trait aggression (e.g. Anguiano-Carrasco, Vigil-Colet, & Ferrando, 2013). For example, self-report measures, word completion tasks and apportionment of aversive stimuli. However, owing to the dynamic nature of state aggression, only trait aggression has been considered throughout this thesis.

Notable examples of measures used to assess aggressiveness have been how many needles were used to puncture a voodoo doll (Dewall et al., 2013) or dart throwing accuracy when throwing darts towards images of human faces (Mussweiler & Förster, 2000). Possibly, the most widely adopted approach has been to provide participants with the belief they were to deliver a punishment to another individual (Anderson and Carnegey, 2004). This has been used across several techniques. For example, creating the opportunity to verbally assault an opponent or confederate (Berkowitz, 1970; Mosher & Proenza, 1968); deliver electric shocks to an opponent (Berkowitz & Buck, 1967; Epstein & Taylor, 1967) and modifications thereof.

The Hot Sauce paradigm (Lieberman, Solomon, Greenberg, & McGregor, 1999) was a modification where the measurement of the weight of condiment assigned to an opponent (occasionally, the measure was simply "allocated" or "non-allocation") was suggested to be positively correlated to how aggressive an individual was and thus, the method could be used as a behavioural index of aggression (e.g. Lieberman, Solomon, Greenberg, & McGregor, 1999; Ayduk, Gyurak & Leurssen, 2008). However, there has been no validation of this method conducted outside the laboratory and neither has any known research established the measure's association with aggressive cognition or behaviour (Adachi & Willoughby, 2011).

The frequently implemented Taylor Reaction Competitive Time Test (Taylor, 1967) has been used with a variety of aversive stimuli as a punishment/retaliation measure. For example, the classic electric shock (Phillips & Giancola, 2008); finger pressure from compressed air (Lotze, Veit, Anders, & Birbaumer, 2007) or via a noise blast (Anderson & Dill, 2000; Denson, Capper, Oaten, Friese, & Schofield, 2011; Denson, Pedersen, et al., 2011; Engelhardt, Bartholow, Kerr, et al., 2011; Wiswede et al., 2011). Although the change to a noise blast from the classic electric shocks has often been perceived as addressing ethical concerns, there have been several researchers that have questioned the validity and reliability of the measure (Adachi & Willoughby, 2011, 2013; Ferguson & Rueda, 2009; Ferguson, Smith, et al., 2008; Tedeschi & Quigley, 1996, 2000).

In one use of the measure, Anderson and Dill (2000) concluded that although the intensity of noise blast did not differ between groups (nonviolent verses violent videogame players), the duration of the noise blast showed differences. Namely, those who had played a violent videogame gave longer blasts of noise to their 'opponent' (violent videogame players mean=6.81ms verses non-violent videogame players mean=6.65ms). Although females did respond with longer mean durations than males suggesting that this measure showed females were more aggressive than males, what was imperative to note was that the participants had been taught how to modify the noise blast duration and thus, they had potentially fallen victim to demand characteristics and presumed they ‘should’ modify the noise as had been instructed (Ferguson & Dyck, 2012). Hence potentially, this showed that females were more likely to follow commands or use newly learned behaviours than males.

Other modifications of the TRCTT (e.g. Anderson & Dill, 2000; Anderson & Murphy, 2003; Bartholow et al., 2006; Engelhardt, Bartholow, Kerr, et al., 2011; Engelhardt, Bartholow, & Saults, 2011; Hasan, Begue, & Bushman, 2013; Hasan, Bègue, Scharkow, & Bushman, 2013) have invited critique regarding the lack of using a standardised and validated method which can potentially lead to spurious interpretation of the results that could have capitalised on random chance (Elson, 2016; Elson et al., 2014; Ferguson & Rueda, 2009; Ferguson, Smith, et al., 2008). Adachi and Willoughby (2011) suggested that this tool more adequately measured competitiveness than aggression. Thus, within the applied context, the TCRTT could be viewed as lacking in both face and ecological validity. Ferguson (2009) stated that this was unlikely to be an isolated issue with this measure however, it has demonstrated that the choice of measurement tool and researcher integrity (e.g. the tool has the potential to enable the researcher to choose a favourable outcome) could possibly have impacted the overall validity and robustness of research in this area (Ferguson, Smith, et al., 2008; Glaser, Mendrek, Germain, Lakis, & Lavoie, 2012).

In comparison, open-ended stem stories have allowed researchers to gather subjective information from a qualitative perspective, with an additional degree of ethical consideration. Bushman and Anderson (2002) conducted an investigation to test the link between brief VM exposure, short term aggression and hostile expectation bias. They used open-ended stem stories that requested participants to answer the question; ‘’What happens next?’ after playing a violent videogame as a measure of aggressive tendency. Results demonstrated that participants who had played the violent videogame expressed more aggressive expectations in comparison to those who had played a non-violent videogame. Barlett, Harris, and Baldassaro (2007) also used open ended story stems but modified the method slightly to require participants to answer from their personal perspective rather than on behalf of a character within the VM they had been exposed to. Additionally, participants were asked to complete a Likert scale to demonstrate how likely they were to respond in a negative manner post negative behaviour towards them. However, inference of actual future behaviour from the participant responses in this experiment should be viewed as unwarranted as there had been no investigation into the relationship between what the participants said they would do and whether their behavioural response replicated this (Giumetti & Markey, 2007).

Thus, the use of story stems has raised questions surrounding attempting to impose qualitative measures to real world applications as the method can offer no quantitative, psychometric measure of trait aggression. In addition, these types of methods rely on subjective interpretation as a way of measuring aggression thus, can offer no understanding of long term effects of repeated media exposure. Furthermore, it cannot account for any confounding variables (e.g. previous experiences) or socially desirable responses (e.g. Kirsh, 1998) and fails to measure real-life reactions, behaviours and responses. With the use of additional Likert scales, it merely acknowledges what a participant ‘thinks’ they may do when faced with a particular situation (Giumetti & Markey, 2007). Thus, the measure could be viewed as lacking validity in real life contexts.

Opposingly, self-report quantitative measures have provided an ethical alternative measuring tool to gauge aggressive behaviours and cognitions. The Buss and Perry (1992) Aggression Questionnaire (BPAQ) was the product of multiple factor analyses that updated The Buss-Durkee Hostility Inventory (Buss & Durkee, 1957). The BPAQ has been considered the gold standard and has continued to be a widely adopted and highly regarded psychometric measure (Gerevich, Bacskai, & Czobor, 2007). The 29-item questionnaire records self-reported aggressive traits. Scores on the four subcategories (Physical Aggression (PA), Verbal Aggression (VA), Anger (A) and Hostility (H)) have been combined to produce a total aggression score. High test/retest reliability, construct and internal validity for the subcategory scales have been found alongside cross cultural validation (Felsten & Hill, 1998; Gerevich et al., 2007; Pechorro, Barroso, Poiares, Oliveira, & Torrealday, 2016).

There have been established sex differences found in BPAQ responses (Buss & Perry, 1992). Males have tended to score higher on PA and females have scored slightly higher on VA. However, there have been inconsistencies across findings. For example, Ramirez, Fujihara, and van Goozen (2001) conducted a cross cultural study and only found significant sex differences in the H trait. Nevertheless, Keller, Hurst, and Uskul (2008) found an alpha reliability of 0.85 when the subgroup totals were combined. Thus, suggesting that all subgroups shared covariance and had a high indication of measuring the same concept (Field, 2013; Tavakol & Dennick, 2011). Becker (2007) investigated the extent to which social desirability responses confound the variance across item scores. It was argued that although social desirability response was a sizable confound, the overall effect was minimal, likely to be comparable to other susceptible methods and had been well addressed by Buss' item writing techniques (see Becker, 2007).

Although there is no known exact point/value at which aggressive scores have been considered to be high or low, the BPAQ has been validated on forensic samples with known violent and aggressive individuals, thus providing a value at which known trait aggression has been identified as behaviourally and potentially cognitively different from non-aggressive individuals (Archer, 2004; Archer & Webb, 2006; Stanford, Houston, Villemarette-Pittman, & Greve, 2003; Zillmann & Weaver, 2007). Known offender bullies scored in the region of 81 (controls scored a mean of 77) (Palmer & Thakordas, 2005) and known violent offenders provided mean total scores of 86 (Smith & Waterman, 2004) in comparison to controls who scored a mean of 72. This appeared to have demonstrated that the window of difference between aggressors and controls has been relatively slim but, distinct.

Within this field of research, there has been a lack of defined cut-off values for the measures of aggression (Ferguson, Rueda, et al., 2008). Via the unstandardized use of the variety of measurement tools, it has been unclear whether noise intensity and/or duration adequately defines aggressiveness or whether a specific volume of hot sauce can render someone as being an aggressive person (e.g. how much hot sauce does it require to be viewed as aggressive? How long must the duration of noise be or the height of volume or what is the number of times a participant must be repeatedly scoring high values in the TRCTT to be considered aggressive?). In order to account for this, continuous scales and statistical methods to 'control for' aggression could be applied. But, evidence has suggested that this would be an inappropriate use of this type of measure in this particular case (see chapter 2.4.1 Types of Analysis for further explanation) (Field, 2013). However, it was clear that specific cut-off values should be used (e.g. Ferguson, Rueda, et al., 2008) as there is no sliding scale of trait aggressiveness, individuals either are, or are not, aggressive (as compared to state aggression that has been considered more fluid). In line with the above justifications, the BPAQ was considered most ethical, reliable and valid for use across the experimental chapters of the thesis.

1.3 **Theories of Aggression**

There have been multiple theories of aggression (see Eron (1994) or Geen (2001) for an overview). The first documented theoretical explanation of aggression, a paper titled "Frustration and Aggression" (Dollard, Miller, Doob, Mowrer, & Sears, 1939), was a behaviouristic approach to Freud's (1915) psychoanalytic thinking and although it acknowledged a biological basis of aggression, it assigned a predominant role to the learning of aggressive behaviour (Eron, 1994). The paper hypothesised that frustration always lead to aggression but, a later correction by Miller (1941) deprived readers of this inevitability, instead, Miller (1941) provided that although frustration generally had led to aggression, it was not always the case. Based on previous learning and personality, it was proposed that frustrated individuals may respond in alternative ways such as withdrawing, experiencing depression or feelings of guilt (Berkowitz, 1989). Therefore, this suggested that initial direct causal links to one defining variable was difficult as numerous other factors required prior meticulous consideration.

Several cognitive theories of aggression have been formulated since the early work by Dollard et al (1939) and the majority of these have been based on the Social Learning Theory (SLT) (Bandura, 1978). The SLT suggested that aggression was imitated via observational learning (e.g. the bobo doll paradigm) and reinforced via experience or vicarious observation. Much in the same way Skinner's (1948, 1953) operant conditioning stated that behaviour was repeated based on positive or negative reinforcement, the SLT suggested that the probability of repeating or imitating a behaviour was relational to the magnitude of the positive reward (Elson, 2016). However, it was convincingly argued that the children in the classic 'Bobo doll' experiments could have been merely enjoying the rough and tumble play (Tedeschi & Quigley, 1996), whilst others have suggested that the children's behaviours were a product of demand characteristics and not a direct result of learning (Ferguson & Dyck, 2012). Subsequently, the experimental basis of the SLT (Bandura, Ross, & Ross, 1961) has been criticised for methodological and ethical flaws (Ferguson & Dyck, 2012; Ritter & Eslea, 2005).

Nevertheless, Huesmann (1988) supported Bandura's position on learned aggression and the suggestion that observed violence developed violent cognitive scripts which could be rehearsed for later recall. Huesmann's (1988) Script theory posited that children with predefined aggressive cognitive scripts could recall them from memory and refer to them throughout childhood and into adulthood. According to Huesmann (1988), this demonstrated that the aggressive script construct was resistant to change and furthermore, if left unchallenged, the learned scripts could hypothetically manifest into violent and aggressive behaviour (Huesmann, 1988).

Zillmann (1988) stated that once physical arousal had been triggered, it took time for the body and brain to return to a biological state of equilibrium. Thus, as outlined in Zillman's (1988) Excitation Transfer Model, it was suggested that arousal could be transferred from situation to situation where both physical and cognitive effects could be intensified and therefore, could possibly explain how individuals may seem to be responding in an excessive manner to any given situation.

Berkowitz (1989, 1993) also recognised the importance of cognition, postulating that it was a fundamental element in aggression and proposed the Cognitive Neoassociation theory (also known as the Aggressive Cue Model or the Negative affect theory, Bushman and Anderson, 2002). Berkowitz (1989, 1993) reasoned that negative life experiences and emotions were the key features in aggressive behaviour. Events or cues, such as violent or erotic media exposure, could prime future aggression and produce a negative effect that may trigger both cognitive and physiological responses usually affiliated with fight or flight (Berkowitz, 1989, 1990, 1993; Berkowitz & Buck, 1967; Cannon, 1929). It was suggested that, dependant on individual motivation, these influences had the potential to increase aggressive behaviour (Berkowitz, 1989; 1993).

The SLT (Bandura, 1977); The Cognitive Neoassociation theory (Berkowitz, 1989; 1993); Script Theory (Huesmann, 1988) and the Excitation Transfer theory (Zillmann, 1988; Zillmann & Bryant, 1974) were all influential theories that informed one of the most widely adopted, contemporary, socio-cognitive models of aggression; the General Aggression Model (GAM) (Allen et al., 2018; Anderson & Bushman, 2002). A recent online search returned 161,000 results and 1254 individual journal articles that referred directly to the terms "The General Aggression Model" or "GAM" (Anderson and Bushman, 2002). The articles were shown to be distributed across disciplines however, the majority were from Psychology, Medicine, Social Work, Social Welfare and Political Science. Thus, it can be understood that the GAM has served as a current, far reaching and well acknowledged theoretical framework that has been adopted and accommodated across an array of topics (Allen et al., 2018; Groves, Prot, & Anderson, 2016).

The GAM integrated social, cognitive, developmental and some biological factors in order to define both short and long-term processes that could lead to aggressive behaviours (see figure 2.) (Anderson & Bushman, 2002; Groves et al., 2016). The short-term processes were defined within the single cycle episode (see Figure 1.). Personological and situational variables were theorised to interact and have a direct effect on the internal state. The internal state included affect, cognition and arousal. Barlett, Branch, Rodeheffer, and Harris (2009) suggested that the short-term process (cognitive and physical) effects of media exposure lasted up to 10 minutes. During which it is suggested that the appraisal makes physiological and cognitive (e.g. script and schema formation) modifications which are then relied upon in future social, ambiguous or hostile situations (Anderson & Bushman, 2001, 2002; Anderson & Carnagey, 2004; Barlett, Harris, & Bruey, 2008). Support could be drawn from research that has shown higher scores on cognitive measures of aggression for those that have played a VVG (Barlett & Rodeheffer, 2009; Bartholow et al., 2006; Funk, Baldacci, Pasold, & Baumgardner, 2004; Giumetti & Markey, 2007) and research demonstrating differences in physiological measures (Anderson & Carnagey, 2009; Arriaga, Esteves, Carneiro, & Monteiro, 2006; Engelhardt, Bartholow, Kerr, et al., 2011; Persky & Blascovich, 2007) and neurological response post VM exposure (Bartholow et al., 2006; Engelhardt, Bartholow, Kerr, et al., 2011; Tamamiya, Matsuda, & Hiraki, 2014).

The GAM's long-term processes have explained how repeated chronic media exposure (e.g. violent videogames; pornography; films) whether real-life or fiction, can provide the rehearsal and reinforcement of relational cognitive scripts that across time, can modulate beliefs, attitudes, perception, behavioural norms and desensitize (reduction in emotional and physiological responses) the individual to the media content (Allen et al., 2018; DeWall, Anderson, & Bushman, 2011; Engelhardt, Bartholow, Kerr, et al., 2011; Funk et al., 2004; Groves et al., 2016). Therefore, the repeated aggressive script formation and retrieval was theorised to have permanent modifying effects on the brain and personality (e.g. trait aggression) across time (Anderson et al., 2010). Support could be drawn from an established finding that learning causes physical neurological changes (Bueti, Lasaponara, Cercignani, & Macaluso, 2012; Draganski et al., 2006; Hilton, 2013; Patel, Spreng, & Turner, 2013).

Further evidence has suggested that exposure to media violence was directly linked with detrimental, potentially long-term, cognitive and physiological changes (Barlett, Vowels, Shanteau, Crow, & Miller, 2009; Bushman & Huesmann, 2006; Carnagey & Anderson, 2005; Gentile, Li, Khoo, Prot, & Anderson, 2014). For example, research has linked playing VVGs and violent film exposure to increased physiological measures (e.g. heart rate (HR); blood pressure (BP); skin conductance (GSR)); neurological measures (e.g. differences in event related potential (ERP) amplitude and latency) (Barlett et al., 2007; Bluemke, Friedrich, & Zumbach, 2010; Engelhardt, Bartholow, & Saults, 2011; Fernandez et al., 2012; Palomba, Sarlo, Angrilli, Mini, & Stegagno, 2000) and cognitive aggression scores (Bartholow et al., 2006; Funk et al., 2004). Both violent and sexually violent media exposure has been shown to distort normative beliefs about real world violence and modify views about appropriate behavioural responses in hostile or sexual situations (Funk et al., 2004; Godleski et al., 2010; Greitemeyer, 2014; Groves et al., 2016; Hald & Malamuth, 2015; Malamuth et al., 2011; Tomaszewska & Krahé, 2016; Vega & Malamuth, 2007).

These findings have been supported by a vast array of research that has stated VM exposure primes aggressive scripts (Coyne, Linder, Nelson, & Gentile, 2012; Coyne, Robinson, & Nelson, 2010; Loftus, Loftus, & Messo, 1987; Loftus & Palmer, 1974), desensitizes individuals towards violent content (Engelhardt, Bartholow, Kerr, et al., 2011; Fanti, Vanman, Henrich, & Avraamides, 2009; Krahe et al., 2011), associates hostile attributions to future social situations (Gagnon et al., 2017; Godleski, Ostrov, Houston, & Schlienz, 2010), decreases prosocial behaviour (Anderson et al., 2010; Bushman & Anderson, 2009), increases aggressive thoughts and diminishes normal inhibitory behavioural effects (Bartholow et al., 2006; Bartholow, Sestir, & Davis, 2005; Engelhardt, Bartholow, Kerr, et al., 2011; Krahe et al., 2011), and can subsequently increase the likelihood of committing violent crime (Huesmann, Moise-Titus, Podolski, & Eron, 2003).

By implication, the GAM has suggested that EM could have an effect on sexual aggression (Anderson & Bushman, 2002; Groves et al., 2016). This view echoed previous theoretical models such as the Indirect Effects Model (IEM) (Malamuth and Briere, 1986) and the Confluence Model (CM) (Hald & Malamuth, 2015; Malamuth et al., 1996). Malamuth and Briere (1986) suggested that the originating variables (e.g. mass media) could influence intermediate responses (e.g. cognition, sexual arousal, motivation, emotion and characteristics of personality) and this could lead to an increase in antisocial behaviour. This included conducting sexually promiscuous behaviours, being outwardly supportive of conducting sexually aggressive acts and committing sexually violent acts.

For some, EM use has been considered a widespread health concern (Perrin et al., 2008; Voon et al., 2014) and although a full review of research linking (or failure to link) EM use with key variables is beyond the scope of this thesis, research has related EM use with increased anxiety (Voon et al., 2014); poor academic performance (Beyens, Vandenbosch, & Eggermont, 2014); sexual dysfunction (Park et al., 2016); relationship problems and dissatisfaction (Doran & Price, 2014; Poulsen, Busby, & Galovan, 2013; Wilson, 2016); impacts of sexuality (Wright, 2011) and an active need for an ever developing, stronger content (Sun, Miezan, Lee, & Shim, 2014; Wéry & Billieux, 2016). However, for some researchers, the results remain inconclusive (e.g. Ferguson and Hartley, 2009; Wright, 2013) with a wide range of individual factors with potential mediating effects e.g. culture, education, trait aggressiveness.

Most theoretical models have proposed that the mere exposure (Zajonc, 1968) of erotic or pornographic material has a potentially long-lasting effect. The phenomenon was based on the familiarity principle that suggested that preference towards a specific media was simply due familiarity (Zajonc, 1968). Hence, there was a positive relationship between exposure and preference. As the frequency of exposure climbs, so too does the preference for that media. However, research investigating repeated exposure to EM found that although interest in the subject remained constant, there was no evidence to suggest that preference towards that type of media had increased (DasGupta, 2017; Montgomery-Graham, Kohut, Fisher, & Campbell, 2015). Thus, contrary to earlier findings, this has suggested that not all media content has the same effect. It has been documented that attention is motivated towards imagery where there is content relevant to basic biological drives (e.g. Fight or flight and reproduction) (Schupp et al., 2000; Schupp, Cuthbert, et al., 2004; Schupp, Junghofer, Weike, & Hamm, 2003, 2004; Weinberg & Hajcak, 2010; Wheaton et al., 2013).

This type of motivated attention was associated with ''phyletic memory'' (Fuster, 1995, 2009). Fuster (2009) referred to this as the "memory of the species" (p.2062) and it is an evolutionary based memory concerned with basic biological drives (e.g. reproduction, feeding and fear response). This primal memory could aid in the explanation of automatic physiological responses toward both VM and EM. This was supported by Schupp et al. (2003) who found selective attention was directed towards emotive imagery and it has been repeatedly reported that highly arousing VM and EM evoked increased event related potential (ERP) amplitudes in comparison to neutral imagery and other less arousing affective images (Cuthbert, Schupp, Bradley, Birbaumer, & Lang, 2000; Schupp et al., 2000; Schupp, Cuthbert, et al., 2004; Schupp, Junghofer, et al., 2004).

The relationship between EM and sexual aggression has been summarised in several meta analyses (Kingston, Fedoroff, Firestone, Curry & Bradford, 2008; Wright et al., 2016). As suggested by Vega and Malamuth (2007) and

Yang and Youn (2012), the general consensus has been that increased EM exposure (violent and non – violent) was associated with an increased acceptance of violence against females. EM exposure where the content depicts sexually violent and aggressive behaviours has been related to sexually aggressive attitudes and behaviours against females (Hald & Malamuth, 2015; Malamuth et al., 2012). However, Ferguson and Hartley (2009) and Vega and Malamuth (2007) have suggested that caution should be exercised as many of the studies reviewed have been correlational research therefore, consideration must be given to the possibility that pornography and EM may have been, at best, a spurious marker.

As previously noted, EM is one of the most widely accessed global medias (e.g. HBAT, 2016; Fisher et al, 2013) and by the time early adulthood is reached, most are "porn-literate". However, for a minority, EM use has become chronic and addictive (Braun-Courville & Rojas, 2009; DasGupta, 2017; Hilton, 2013; Love, Laier, Brand, Hatch, & Hajela, 2015; Young, 2008). Although the Diagnostic and Statistical Manual (version 5) has not classified EM use as an addiction, there are some similarities in both biological and behavioural markers in behavioural and substance addictions (Blum et al., 2012; Hilton, 2013; Love et al., 2015). This evidence has suggested that exposure to EM could be contributing to a moderating and potentially debilitating effect on the brain, personality and subsequently behaviour.

Both the IEM (Malamuth and Briere, 1986) and the CM (Malamuth, 2000; Malamuth et al., 2012) have emphasised several alternative variables and risk factors that could be contributing elements for sexual aggression. Malamuth et al. (2012) stated that there was statistical evidence of crucial moderating variables that could not be explained by EM exposure alone thus, suggested that the plausibility of there being a direct causal relationship between EM use and sexually aggressive behaviour was relatively low (e.g. Malamuth and Briere, 1986; Malamuth et al., 2012) but, it could play an influential and contributory role.

The EM deemed to have the most negative effect are those that depict the objectification of sexual relations and seek to dehumanise. This is especially the case if the EM depicts violence (DasGupta, 2017). However, Malamuth et al. (2000) suggested that the effects were relative to how aggressive the participant was. The interpretation and response towards the same EM could have differing effects between aggressive and nonaggressive individuals. Much of the empirical research has also supported this (Malamuth et al., 2000; Malamuth et al., 2012; Vega & Malamuth, 2007; Yang & Youn, 2012).

Rupp and Wallen (2008) found that over half of the violent sexual offenders interviewed reported using EM and having an early exposure. However, these figures appear relatively consistent with non-offender groups and adolescents (Mancini, Reckdenwald & Beauregard, 2012). Recent cross-sectional survey data revealed that over half the adolescents questioned admitted to visiting sexually explicit websites (Braun-Courville & Rojas, 2009). It was concluded that exposure to internet EM had potential implications on sexual relationships. However, it was acknowledged that further research was required to extend these findings to fully understand the influence EM had on youth attitudes and behaviour (Braun-Courville & Rojas, 2009).

It has been shown that when EM has positive portrayals (i.e. accurate information and responsible messages) it can be an effective tool for teaching socially acceptable and responsible cognitions and behaviours (Collins, Elliott, Berry, Kanouse, & Hunter, 2003). Others have suggested that EM actually has a catharsis, or tempering effect on sexually violent aggressive acts (DasGupta, 2017; Ferguson & Hartley, 2009; Mancini, Reckdenwald, & Beauregard, 2012). This view was previously suggested in a review conducted by Diamond (2009) who concluded that as EM availability increased, sexual related crimes decreased or plateaued. Additionally, where scientific methods have been used to investigate EM use, there were global evidence of acceptance of its use.

As shown above, recently the literature has begun to contest the belief that there is a unilateral detrimental effect of EM use and exposure (see Klein, 2016). Kohut, Fisher, & Campbell (2017) found there were no perceived negative effects found in relationships where one, or both, partners used EM. Ley, Prause, and Finn (2014) stated that the moral panic regarding EM use was based largely on poor evidence that eagerly sought to fuel a lucrative treatment industry and there were calls for closer scrutiny for findings across the field.

Due to the wealth of support for the GAM (e.g. Anderson, 2004; Anderson & Bushman, 2001; Anderson & Carnagey, 2009; Anderson et al., 2003; Anderson, Deuser, & DeNeve, 1995; Anderson & Dill, 2000; Anderson & Murphy, 2003; Bartholow et al., 2006; Bartholow, Sestir, & Davis, 2005; Bushman & Anderson, 2002; Bushman, Rothstein, & Anderson, 2010; Greitemeyer, 2014; Greitemeyer & McLatchie, 2011; Greitemeyer & Mugge, 2014; Grimes et al., 2008; Groves & Anderson, 2015a, 2015b; Groves et al., 2016; Huesmann, 2010), many have insisted that the findings are undoubtedly clear and linear; media violence exposure causes increased aggression (Anderson et al., 2010; Bartholow et al., 2006; Bushman, 2016; Bushman & Anderson, 2002, 2009; Groves & Anderson, 2015a, 2015b; Groves et al., 2016). However, as has been demonstrated results are questionable for VM and are even less clear for EM.

Moreover, there has been a plethora of research and findings that have failed to support the GAM and have illuminated a growing body of methodological questions and criticisms (i.e. the use of non-standardised measures, inconsistent use (by the same author) of measures, publisher and citation bias, no baseline measures, the use of unbalanced stimuli, non-disclosure of stimuli used, small effect sizes) (Barnett & Coulson, 2010; Ferguson, 2007a, 2010; Ferguson & Cricket Meehan, 2010; Ferguson & Dyck, 2012; Ferguson, Olson, Kutner, & Warner, 2014; Savage & Yancey, 2008; Sherry, 2001). Whilst some have highlighted the positive effects of media exposure (Diamond, 2009; Wilms, Petersen, & Vangkilde, 2013), others have suggested that the 'causal claims' require extensive additional research in order to clearly demonstrate the media and aggression link in a valid and robust fashion (e.g. Elson, 2016; Ferguson & Dyck, 2012).

It has been argued that the GAM overinflated the effect of the media, underestimated the effects of additional 'third' variables (Ferguson et al., 2014; Ferguson, Rueda, et al., 2008) and failed to investigate the potential alternative variables which could have led to an overestimation in media effects. Ferguson (2011) and Ferguson & Dyck (2012) suggested that despite distal processes and causes (e.g. personality, biological and environmental modifiers) being included within the extended dual process diagram (see Figure 3.), there has been minimal explanation of how these alternative factors interact with the effects of the media and suggested that they have not been empirically explored in relation to media exposure. Therefore, the true extent of each has still yet to be clearly defined (Elson, 2016; Elson et al., 2014; Ferguson, 2007a, 2007b; Ferguson & Cricket Meehan, 2010; Ferguson & Dyck, 2012; Ferguson & Garza, 2011; Ferguson et al., 2013; Ferguson & Hartley, 2009; Ferguson & Kilburn, 2010; Ferguson & Olson, 2014; Ferguson, Olson, Kutner, & Warner, 2014; Ferguson & Rueda, 2009; Ferguson, Rueda, et al., 2008; Ferguson et al., 2012; Sarah, Laura, & David, 2012).

Ferguson et al. (2014) investigated VVG exposure on delinquency and bullying behaviours whilst taking into account some additional contributing variables (e.g. parental involvement; trait aggression; stress; participation in extracurricular activities; family and peer support network). Findings showed that delinquent behaviours and bullying were predicted by trait aggression and stress level. There was no effect found for delinquent behaviour, bullying or parental involvement for VVG play/ exposure. Thus, highlighting that the field had not yet exhausted investigation and could not explain these conflicting findings.

After examining published research from 1995 to 2007, Ferguson (2007) conducted a meta-analysis to investigate the effects of VVG play on aggressive behaviour and the effect of citation / publication bias. The Pearson's r correlation was used as a metric of the effect magnitude across the research. With no correction for publication bias, the correlation coefficient was small and viewed as a very weak positive correlation ($r=0.14$) (Field, 2013). Post publication bias control, the magnitude of effect fell to $r=0.04$. A subsequent meta-analysis (research from 1998 to 2008) that utilised longitudinal surveys, cross sectional and experimental research produced a sample size of 12,436 and post correction, the results showed an effect size of $r=0.08$ (Ferguson & Kilburn, 2009).

Thus, this suggested that publication bias could be a crucial factor and potentially, it could further reduce some of the already relatively minimal effect sizes found across the field. However, Lishner, Groves, and Chrobak (2015) argued that they could not support the publication bias effect and claim that Craig Anderson's scholarly prominence went some way to explain the suggested bias effect. Although, caution should be taken as authors listed in the study were some of those that acclaim support for the GAM and the corroborating research. Therefore, unfortunately an unbiased viewpoint cannot be taken.

Based on the above and the GAM's principle foundations that implicitly presume humans are blank slates ('tablu rasa') awaiting media's annotation (Pinker, 2016), there has been calls for the models retirement (Ferguson & Dyck, 2012). The notion of passive modelling has suggested that the GAM views humans as animalistic, mechanistic and without higher understanding of sensibility, humanity, morality and the law (Ferguson & Dyck, 2012). The GAM structure suggests that humans only respond reactively based on previous media consumption and therefore, assumes very little frontal cortical activity during and post media exposure (Ferguson, Smith, et al., 2008). However, neurological frontal activation has been repeatedly recorded in response to differing content (e.g. violent, erotic and media considered neutral) (Antonucci et al., 2006; Denny et al., 2014; Mathews et al., 2005).

The majority of previously provided aggression theories have centred on social learning and the notion that no one is impervious or resistant to the effects. However, biological/ innate motivational theorists have, on the contrary, suggested that an intrinsic motivation can either harbour, or challenge, aggressive behaviour (Pinker, 2016). This belief has gathered support from research showing that a large percentage of variance in aggressive behaviour and antisocial personality traits can be explained via genetic or neurobiological topographies (Larsson, Andershed, & Lichtenstein, 2006; Rosell & Siever, 2015; Siever, 2008). Therefore, illuminating the fact that humans cannot be viewed as dry ‘sponges’ that merely absorb the media. According to Ferguson et al (2008) choices are made (innate or otherwise) that are dependent on many individual factors (e.g. biological differences, subjective experiences, personality, lifestyle choices) that have not been adequately applied or addressed within many mainstream cognitive theories (Pinker, 2016).

A longitudinal investigation by Fikkers, Piotrowski, Weeda, Vossen, and Valkenburg (2013) found a significant interaction between family violence, high VM exposure and an increase in aggressive behaviours. However, it was concluded that individual factors such as social development and family interaction had more explanatory power in aggression than VM exposure. Further evidence has suggested that individual characteristics (e.g. locus of control, previous experience of crime and motivation towards media) were significant predictors of aggressive traits and negative attitudes (Haridakis, 2006; Haridakis & Rubin, 2003). In addition, Bogaert (2001) and Nordstrom and Wiens (2012) argued that media preference was implicitly important in being able to adequately model the media and human aggressive behaviour as individuals actively choose, and are motivated to observe, media content of personal interest. Although there was no direct link made between media exposure and aggression, this research highlighted the importance of motivation and individual differences.

Thus, the GAM (Anderson & Bushman, 2002) was further criticised for its failure to adequately acknowledge the importance of individual differences such as some genetic considerations, culture, past life experiences, media preferences, motivation towards any specific media or the complexity of situational and contextual components (Ferguson, 2007b; Ferguson & Dyck, 2012; Savage, 2004; Savage & Yancey, 2008). In comparison, the Catalyst Model of Aggression (CMoA) (Ferguson, Rueda, et al., 2008) proposed that the development and modification of aggressive and violence prone personalities stemmed from predominantly biological foundations yet, offered additional explanation of other contributing factors (see Figure 4.).

The CMoA placed the effects of VM as comparable to exposure of peer violence. Ferguson, Rueda, et al., (2008) proposed that media exposure was at most, a weak catalyst for those already susceptible to aggressive tendencies and traits. Ferguson indicated that there was no linear model of causation as there were many potential modulating and moderating factors which required additional close investigation. Ferguson (2009) postulated that proximal environmental factors (e.g. real-life events such as family violence and previous personal experience of violent crime) were more robust predictors of aggression than VM exposure as media only functioned as a stylistic catalyst in future behaviours. This was supported by Surrette (2013) who proposed that VM was a ‘rudder’ rather than a trigger for crime after results showed an increase in the likelihood to violently offend when participants (especially males) had been a witness/ victim to real life violence and VM. Cunningham, Engelstätter, and Ward (2016) used a quasi-experimental methodology to explore the effects of VVG sales (using the top 30 selling titles) on violent crime from 2005 to 2011. However, they failed to find evidence of an increase in crime in relation to VVG’s sales rather, suggested there was a possible decrease in violent crime and potential support for the catharsis effect.

A catharsis, or tempering effect has also been suggested for EM use and sexually violent aggressive acts (DasGupta, 2017; Ferguson & Hartley, 2009; Mancini et al., 2012). This view was supported by a review conducted by Diamond (2009) who concluded that as EM availability increased, sexual related crimes decreased or plateaued. Additionally, where scientific methods had been used to investigate EM use, there were global evidence of acceptance of its use. Recently the literature has begun to contest the common belief that there is a unilateral detrimental effect of EM use and exposure (see Klein, 2016). Ley et al. (2014) stated that the moral panic regarding EM use is based largely on poor evidence that eagerly seeks to fuel a lucrative treatment industry and calls for closer scrutiny at findings across the field. Kohut, Fisher, & Campbell (2017) found there were no perceived negative effects found in relationships where one, or both, partners used EM

The majority of research in support of the GAM has been derived whilst investigating the effects of VVG (Anderson & Dill, 2000; Anderson et al., 2010) and the model has been subsequently applied to real world challenges but based on research using predominantly fictional aggression (e.g. fantasy videogames and children’s cartoons). Interestingly, Dewall, Anderson & Bushman (2011) have claimed that the GAM’s explanatory power can now be stretched beyond the laboratory, differing media genre and aggression research. It was suggested that the GAM could be used as a framework to understand, explain and in some cases, potentially prevent, real-world violence and aggression including, societal violence, intimate partner violence, intergroup violence, suicide, terrorist behaviour, torture and global warming and violence (Dewall et al., 2011).

A review provided by Allen et al. (2018) further extended the model's application to be included in contexts such as temperature effects; sexual aggression; personality disorders with aggressive elements and furthermore, demonstrated how the GAM had steered assessment and treatment of violent offenders. Despite these claims, critics consistently hold that the succession of research provided in support of the GAM (e.g. Anderson and Bushman, 2001; Anderson and Carnagy 2002; 2004; 2009; Anderson and Dill, 2000; Anderson et al., 2010; Bartholow, Bushman and Sestir, 2006; Engelhardt et al, 2011) were conducted in a laboratory setting with many critical questions left unanswered (e.g. methodological issues, failure to use baseline measures, the use of inadequate measures of aggression and a reliance on unjustified assumptions) and therefore it could be suggested that both the GAM and the implicated extensions to real world violence, lack any substantial ecological validity and generalisability within reality. Simply stated, research conducted using methods and measures where many lack mundane realism (how often would someone be asked to give an opponent a measure of hot sauce; throw a dart at a human face or deliver an electric shock as a punishment in real life?) in conjunction with the inaccuracies across measurement methodology, questions the ability for that research to be generalized at a populatory level.

Elson (2016), Elson et al. (2014) and Ferguson, Rueda, et al. (2008) highlighted several key issues with the GAM and some of the supporting evidence. For example, Ferguson and Dyck (2012) suggested that there had been an attempt to provide support for the GAM rather than a consistent drive to falsify and test the model. The latter of which should be required to build the foundation of a strong scientifically apt and theoretically justified framework (Witte & Zenker, 2017). Heene and Ferguson (2017) suggested that selective reporting of statistical tests and analyses has placed greater importance on significant p values and lesser importance on non-significant p values. Further stating that this 'file-drawer problem' or publication bias has been evident throughout the field and psychological science for some time. Most often, published work and information released to the public, has supported rather than refuted, a psychological theory, even when in real-life application the theory was false (Fanelli, 2011, 2013). This arises when the likelihood of publication is dependent on the statistical significance of research results (e.g. Schonemann and Scargle, 2008).

The unstandardized use of tools and methodology flexibility (e.g. varying methods of measuring aggression see Ch 1.2.) that has been apparent within the research field could have led to bias within studies where researchers have fallen short to confirmation bias and have aimed to support their hypotheses rather than falsify them. Heene and Ferguson (2017) have identified and outlined these issues with a view to providing psychological science with the understanding of the need to employ statistical transparency and to conjure a change in academic culture. It was suggested that the change needs to lend as much scepticism for significant results as for those non-significant findings; requires acceptance of the principle of failing to accept the null and accepting the null; and actively drive for an academic effort to tighten the methodological flexibility that can convert null results into more publishable significant results (Heene & Ferguson, 2017).

Recently, a selection of researchers have attempted to end the debate on media effects by stating that there is no need for further testing of the GAM or link between media effects and behaviour due to the direct causal link between VM exposure and increased aggression being irrefutably 'proven' (e.g. Allen et al., 2018; Groves, Prot & Anderson, 2016). Groves et al. (2016) concluded that criticism against the GAM and associated supportive research "served to undermine important public policy decisions and confuse parents in need of guidance" (p.31). However, as suggested, many of the criticisms have been based on demonstrating the lack of generalisability and use of robust and valid measures. Thus, questioning whether the critiques were aimed at clouding public judgement or targeted at asking questions in order to strive towards clarity and replicability.

In order to avoid continued debate, it has been suggested that all other explanations (e.g. individual factors such as biological differences, personal experiences, personality, lifestyle choices) should be exhausted and any methodological choices should be investigated thoroughly. This would ensure that there would be minimal possibility that the employment of a method, or measure, would be viewed as a potential to modify or manipulate its use in a way that serves to fit directional hypotheses (Ferguson & Dyck, 2012; Ferguson & Garza, 2011; Ferguson et al., 2013; Ferguson & Kilburn, 2010; Ferguson & Olson, 2014; Ferguson et al., 2014; Ferguson & Rueda, 2009; Ferguson, Rueda, et al., 2008; Ferguson, Smith, et al., 2008; Heene & Ferguson, 2017).

Nonetheless, the basis of the GAM, the IEM, the CM and CMoA and the plethora of evidence provided have encouraged further sensible interest in understanding the effects and subsequent impact of violent and erotic media exposure on the brain and behaviour and has gained extensive support with a vast array of methodologies and investigative technologies. In addition, they have demonstrated that there should be clear differences in neurological response towards differing media (e.g. violent, erotic, neutral) dependant on factors such as trait aggression, sex, personal preference towards violent media and personal life experiences (e.g. previously witness or being a victim of a violent crime).

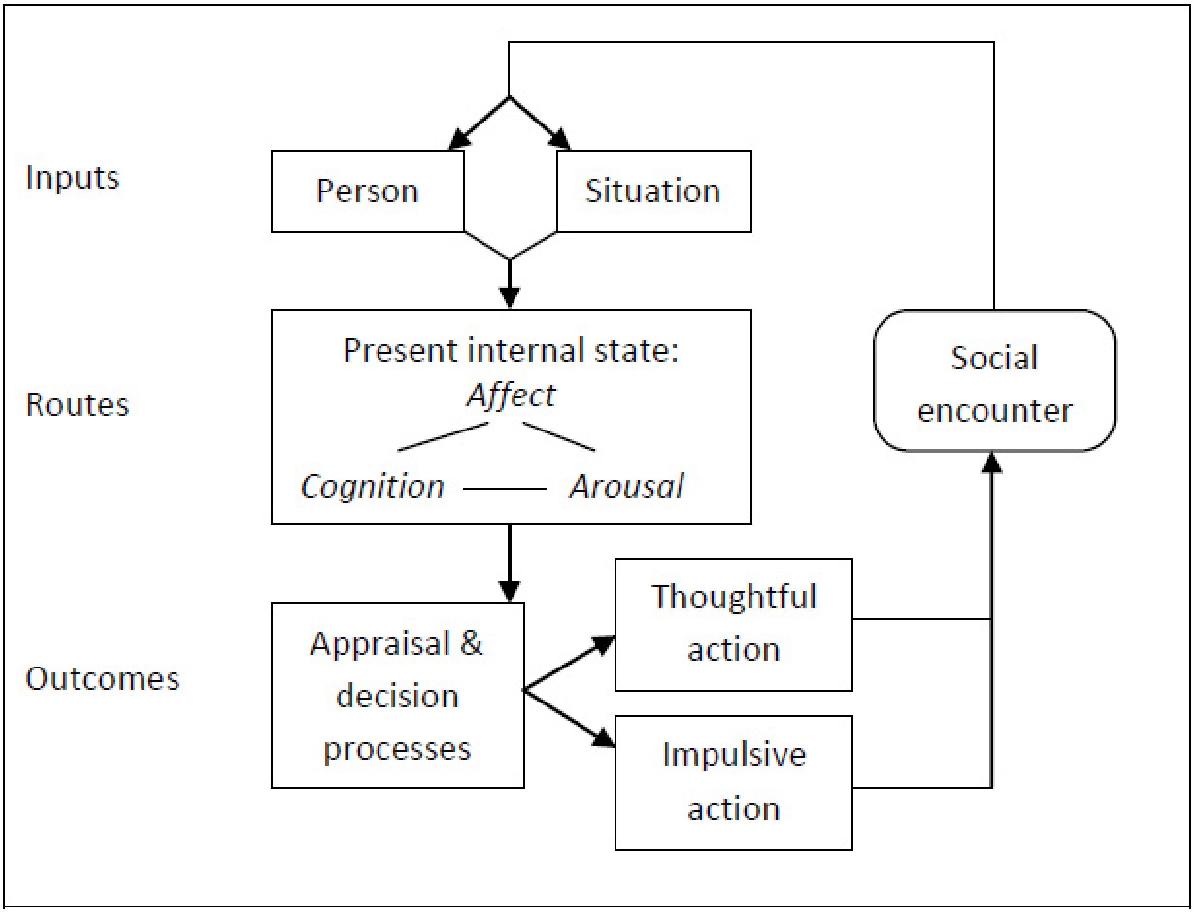


Figure 1. Single-cycle episode within the General Aggression Model (Bushman & Anderson, 2002).

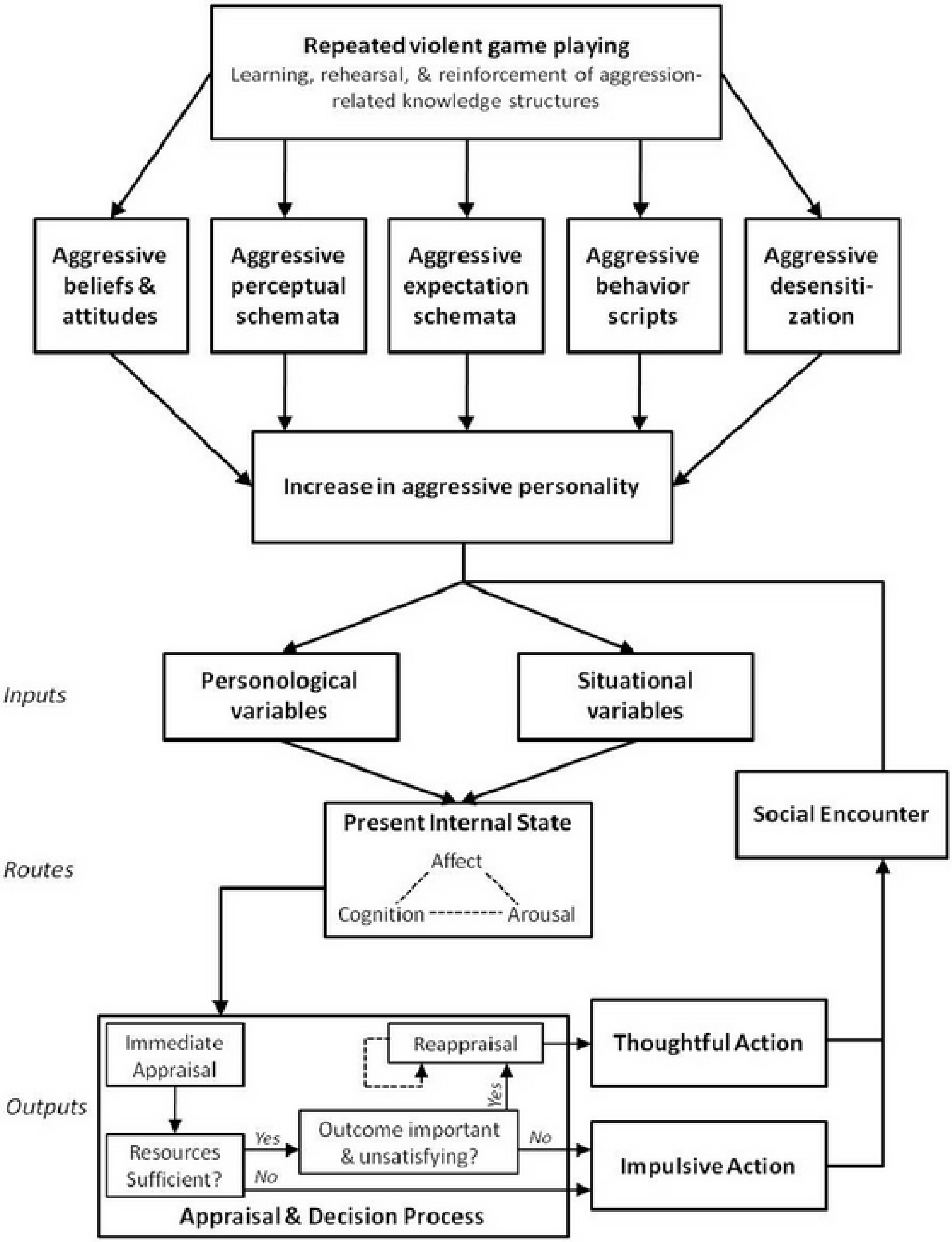


Figure 2. Short and long-term processes within the General Aggression Model (Bushman & Anderson, 2002).

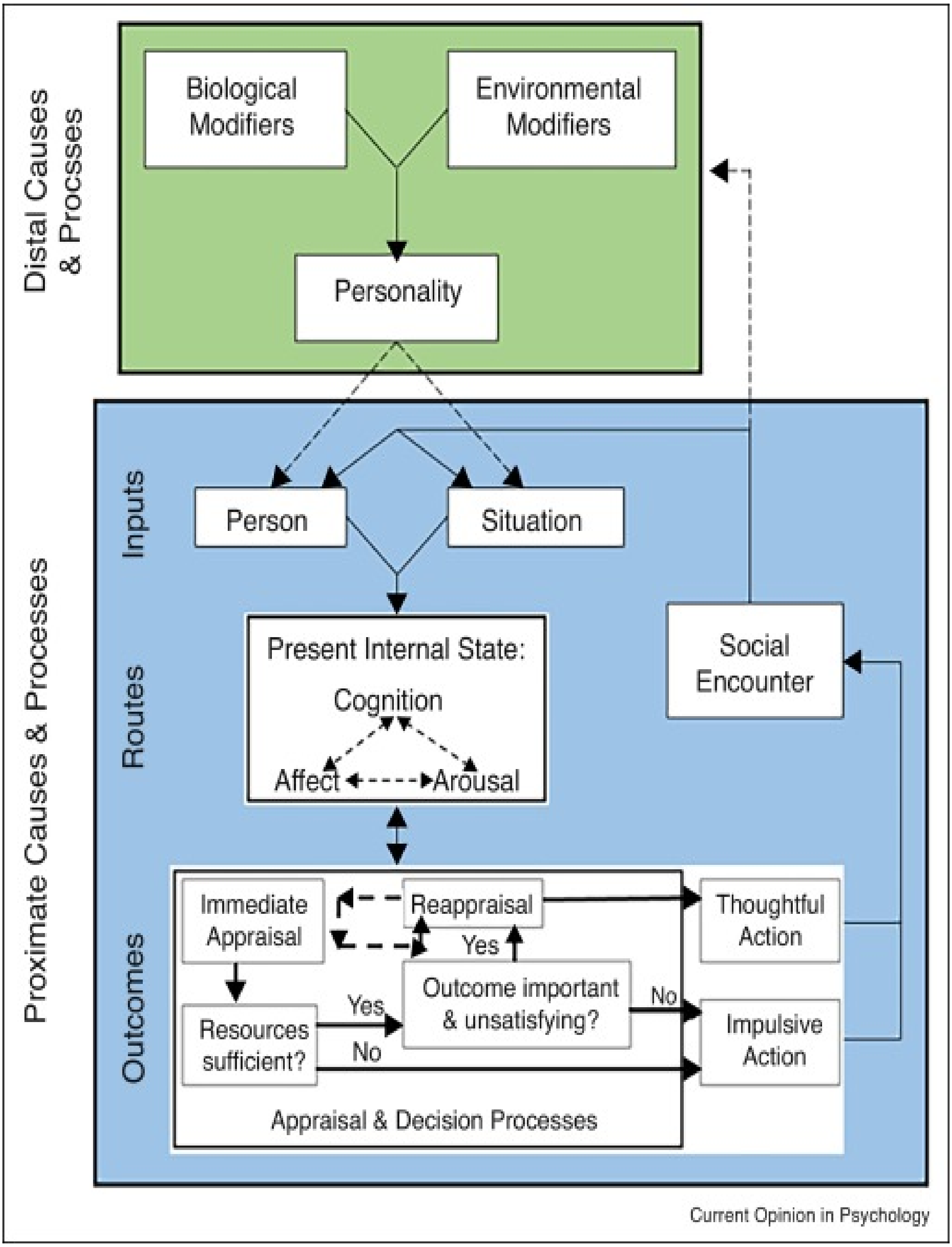


Figure 3. The dual process General Aggression Model: Proximate and distal processes (Allen et al., 2018).

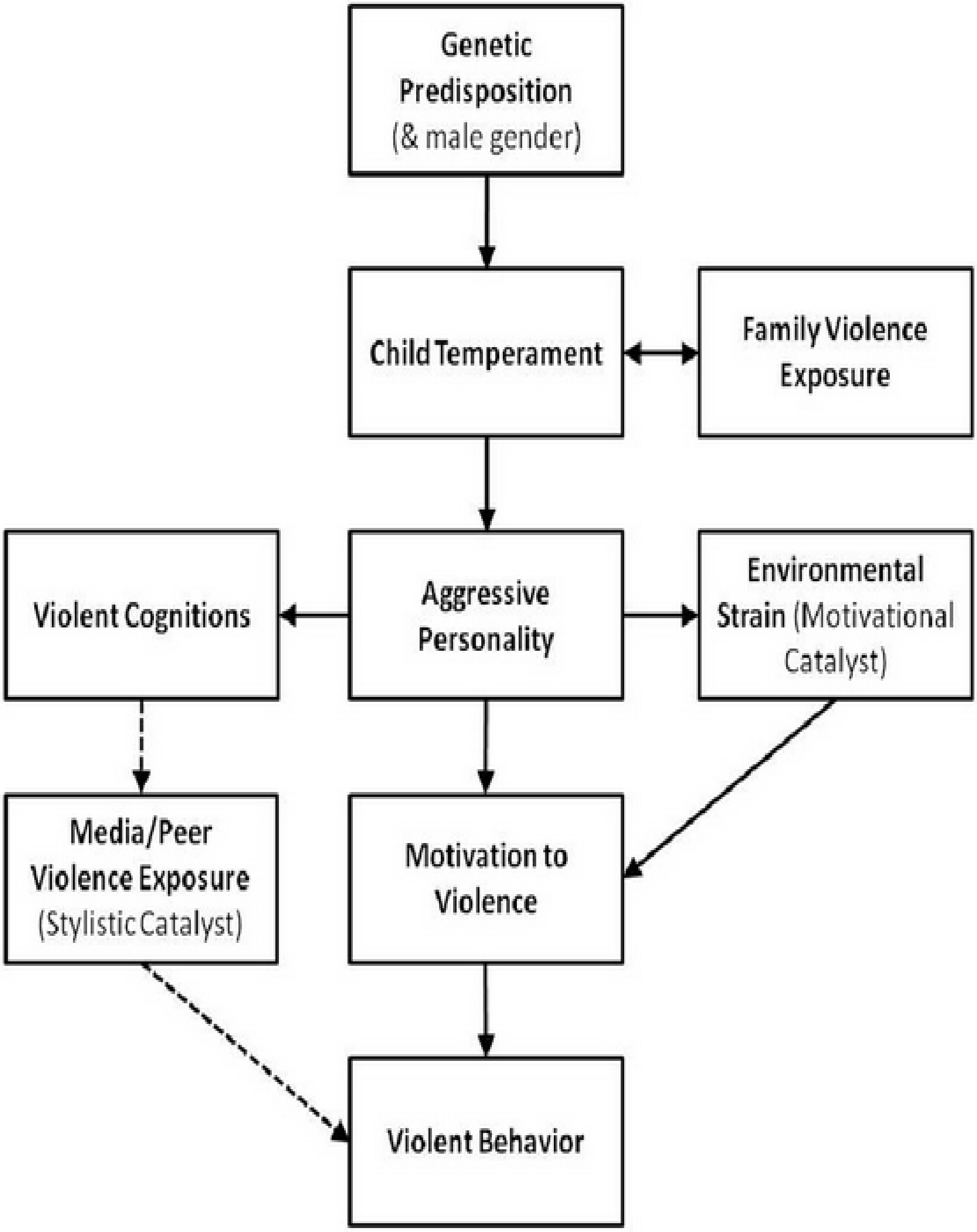


Figure 4. Diagrammatic layout of the multifactor risk-based framework; The Catalyst Model of Aggression (Ferguson et al., 2008).

1.4 The Bio-psychological, Neurobiological and the Electrophysiological Source of Aggression

The subsections above have provided an overview of aggression inclusive of its definition, the prevalence, measures, phenomenological depictions and a theoretical overview. The following section aimed to address the genetic foundations, the basic neurobiology and the electrophysical indices of aggression with a view to understanding whether, as has been suggested (e.g. Anderson and Bushman, 2001; Engelhardt et al, 2011), an exact neurological source or process could be identified to locally target investigation.

Family and twin studies have suggested that aggression (predominantly affective/impulsive aggression in comparison to premeditative aggression) has a significant heritability rate (e.g. 44-72%) (Coccaro, Bergeman, Kavoussi, & Seroczynski, 1997; Siever, 2008; Tuvblad & Baker, 2011) with meta-analysis showing similarity across 24 studies (Miles & Carey, 1997). However, this demonstrates that behavioural genetics cannot explain the whole representation of aggressive behaviours. Environmental and biological factors have been shown to be jointly influential (Loeber & Pardini, 2008). Whilst Miles and Carey (1997) suggested that 50% of the variance in aggression could be explained by genetics alone, alternative factors (e.g. social; economic; environmental; biological; neurochemical) have all been implicated in the development of aggression and have been included in heuristic models (e.g. the GAM: Anderson & Bushman, 2002; the CMoA: Ferguson et al, 2009; see Figure1.: Loeber & Pardini, 2008). However, as has been previously suggested, the role of the media may have been overinflated and the majority of the models can offer very little acknowledgement of the interplay between modelled features and additional individual factors such as lifestyle choices and subjective experiences (Ferguson & Kilburn, 2010).

There has been no further clarity of the basis of aggression among psychobiological research (van Honk, Harmon-Jones, Morgan, & Schutter, 2010). However, it has been suggested that individuals are motivated toward aggressive behaviours due to a hormonal imbalance. For example, steroids; cortisol and testosterone, have been previously established as modulating factors in aggressive behaviour (Montoya, Terburg, Bos, & van Honk, 2012; Pfattheicher, 2017). The predisposition towards aggressive behaviour has been related to elevated levels of testosterone (Archer, 2006) and reduced levels of cortisol. The testosterone/cortisol level ratio (high levels of testosterone and low levels of cortisol) has been identified as a potential key indication for the prediction of aggressive psychopathy and social aggression (Dabbs, Jurkovic, & Frady, 1991; Montoya et al., 2012; van Honk et al., 2010).

For instance, van der Meij et al. (2012) investigated the release of both testosterone and cortisol across a football match where the participant's team won. It was noted that levels of both hormones were higher throughout the match in comparison to a previous control measure. However, neither cortisol or testosterone levels rose after the team's victory. Interestingly, male participants and those deemed as stronger fans of football, experienced a greater increase in cortisol during the match than females. This could suggest that motivated preference can modulate biological changes. However, in a sample of psychopathic inmate offenders, cortisol showed no mediating effect on aggression (Cima, Smeets, & Jelicic, 2008). Hence, the complexity of this relationship still requires further investigation (McAndrew, 2009).

Two neurochemicals; dopamine and serotonin (also called 5-hydroxytryptophan or 5HT) have been implicated as having a significant effect on aggression (Seo, Patrick, & Kennealy, 2008). Specifically, diminished levels of serotonin and/or elevated levels of dopamine (Anstrom, Miczek, & Budygin, 2009; Brunner & Hen, 1997; de Boer & Koolhaas, 2005; P. F. Ferrari, van Erp, Tornatzky, & Miczek, 2003; Montoya et al., 2012; Passamonti et al., 2012; A. Raine, 2008; Seo et al., 2008; A. Smith & Kabelik, 2017; van Erp & Miczek, 2000; Yanowitch & Coccaro, 2011). Recently, pharmacological data has shown robust anti-aggressive effects of 5-HT receptor agonists in dose ranges. de Boer and Newman-Tancredi (2016) stated that the drugs were found to be extremely efficient at activating different subpopulations of 5-HT (1A and 1B) receptors in rats that have concomitantly activated, or inhibited, presynaptic and/or postsynaptic 5-HT neurotransmission that has been linked with aggression (e.g. Seo et al. 2008). Thus, this suggested that aggression was directly influenced by neurochemical fluctuations.

In addition, and central to addiction research, dopamine regulation has been linked with rewarding/ reinforcing behaviour and changes in neuronal plasticity and neurological development (Olsen, 2011). Since impulsive/reactive aggression has been linked with criminal behaviour and several clinical disorders (Seo et al., 2008; Yates et al., 1990), the inclusion and understanding of biological variables reflect their importance as contributing factors even though, to date, there has been no known direct and conclusive evidence that has linked genetics or neurochemical levels, with a media effect and increased aggression.

Using neuroimaging techniques (e.g. functional magnetic resonance imaging (fMRI) and positron-emission tomography (PET)), aggression and sexual aggression have been relatively consistently associated with cortical regions such as the limbic system and the temporal and frontal lobes (Calzada-Reyes, Alvarez-Amador, Galan-Garcia, & Valdes-Sosa, 2013; da Cunha-Bang et al., 2017; Joyal, Black, & Dassylva, 2007; Mathews et al., 2005; Mills & Raine, 1994; Seguin, 2009; Siever, 2008; Strenziok et al., 2011; Tonnaer, Siep, van Zutphen, Arntz, & Cima, 2017; Wiswede et al., 2011). The functional connectivity between the frontal cortex, paralimbic regions (e.g. the medial prefrontal cortex, insula)) and the limbic system (e.g. the amygdala and anterior cingulate) has been implicated as a key feature of emotional processing (Banks, Eddy, Angstadt, Nathan, & Phan, 2007; Costafreda, Brammer, David, & Fu, 2008; K. L. Phan, Wager, Taylor, & Liberzon, 2002). For example, the medial prefrontal cortex was hypothesised to play a vital role in emotional decision making (Etkin, Egner, & Kalisch, 2011; Sergerie, Chochol, & Armony, 2008) and has shown increased activity towards emotive stimuli (Etkin et al., 2011; Glotzbach et al., 2011). A recent review conducted by Bannon, Salis, and Daniel O'Leary (2015) found that despite several structures across the prefrontal, orbitofrontal, temporal, and limbic regions being influential for patients with brain lesions and difficulties in decision making and affect regulation, it was concluded that frontal lobe site disruption showed the greatest influence on violent and aggressive behaviour.

Using a sample of offenders and a non-offender control group, Tonnaer et al. (2017) investigated aggressive behaviour and emotional provocation and regulation. Results showed group differences in BOLD activity during anger and happy minus neutral (baseline) scenarios that required either engagement or distraction. Specifically, violent offenders responded with increased ventrolateral prefrontal activity during anger engagement and a reduction across both ventrolateral and dorsolateral prefrontal areas during anger disengagement in comparison to controls. There were no patterns or differences found for the happy scenarios. Thus, this suggested that not only are these areas paramount to emotional regulation, there were differences in activation between those typically viewed as aggressive and nonaggressive. Therefore, it was suggested that aggressive tendencies could modulate a behavioural response. However, it should be acknowledged that committing a violent offence does not dictate or define trait aggressiveness and neither does being recruited as a control group participant define nonaggressive tendencies.

However, research on violent offender groups has indicated that a combination of increased activity in the limbic region and a decreased activation in prefrontal regions was related to aggressive behaviour (da Cunha-Bang et al., 2017; Tonnaer et al., 2017). Though, a large-scale review conducted by Mills and Raine (1994) that aimed to study the differences in cortical structure between a forensic sample of both violent and non-violent offenders concluded that frontal lobe dysfunction was associated with violent offending, temporal lobe dysfunction with sexual offending and fronto-temporal dysfunction with violent sexual offending. Gatzke-Kopp, Raine, Buchsbaum, and LaCasse (2001) assessed fourteen murderers using both PET and EEG methods and found that violent murderers showed significantly increased slow-wave activation in temporal lobes but, not in any other region.

Support could be provided by Schiffer et al. (2008) who found clear differences in activation across similar neural regions in response towards VSS between heterosexual and paedophile participants. The authors concluded that paedophilia was related to functional issues with neuronal mapping in the frontal lobe (Schiffer et al., 2008). Thus, suggesting that abnormal activation and function in relation to both aggression and sexual aggression has been directly related to areas across the frontal, central, parietal and temporal lobes.

Using structural MRI technology, Schmidt et al. (2017) found greater left amygdala grey matter volume and reduced resting state functional connectivity between the left amygdala and the prefrontal cortex for those with compulsive sexual behaviours in comparison to matched healthy participants. Thus, in line with clinical and neurobiological studies, reduced connectivity and activation between limbic and frontal regions could be central to the explanation of dysfunctional cognitive processing and aggressive, offender behaviour.

Similar cortical structures and regions have been linked with aggression and repeatedly associated with the processing of negative visual stimuli (e.g. VM or EM related to disgust) in comparison to neutral stimuli. Primarily, these have been cortical regions linked with emotion and reward (the limbic system, basal ganglia regions and frontal lobe). These briefly consist of; the occipital parietal temporal areas, the insula, the prefrontal and orbitofrontal cortex with sub-cortical regions such as, the basal ganglia, the thalamus, the hippocampus /parahippocampus and the amygdala being implicated (Alia-Klein et al., 2014; Antonucci et al., 2006; Blair, 2001, 2007; Denny et al., 2014; Engelhardt, Bartholow, Kerr, et al., 2011; Jaworska, Yang, Knott, & MacQueen, 2015; Kiehl, 2006; Kilpatrick & Cahill, 2003; Liberzon, Phan, Decker, & Taylor, 2003; Liberzon et al., 2000; Lithari et al., 2010; Mathews et al., 2005). This has highlighted that there appears to be strong overlap in activation towards negative media (e.g. VM) and activation in response to positive media (e.g. EM without violent content).

Glotzbach et al. (2011) stated that emotional events lead to increased prefrontal brain activation, but its exact involvement remains unclear. Recently, it has been suggested that the prefrontal cortex mediates emotional regulation. Emotional regulation is a fundamental part of societal cohesion as this ability allows the individual to increase or decrease (down or up- regulate) the emotion across behavioural, subjective and physiological aspects. Positive visual stimuli, especially highly arousing EM, has shown increased activation in the occipital parietal temporal region the insula and the prefrontal cortex (Park et al., 2001; Schiffer et al., 2008; Schupp et al., 2003; Schupp, Junghofer, et al., 2004). Increased activation has been observed sub-cortically in the basal ganglia, the thalamus, the amygdala, the hippocampus and the hypothalamus (Park et al, 2001; Stark et al, 2005; Saffron et al, 2007; Schiffer et al, 2008). Thus, demonstrating that structurally, activation towards emotive imagery can be associated with similar locations.

Several neuroimaging studies have shown sex differences in emotional reactivity. Typically, these have emphasised the role of the amygdala towards negative imagery (Andreano, Dickerson, & Barrett, 2014; Filkowski, Olsen, Duda, Wanger, & Sabatinelli, 2017; Stevens & Hamann, 2012). However, using structural neuroimaging techniques it has been shown that sex differences are prevalent across the brain and are surmised to represent distinct differences in inter and intra hemispheric connectivity and function (Filkowski et al., 2017; McGlade, Rogowska, & Yurgelun-Todd, 2015; Stevens & Hamann, 2012; Whittle, Yucel, Yap, & Allen, 2011). However, little has been provided in the literature about the extent of media effects and the actual functional and morphological changes media exposure can have especially, over the prefrontal and frontal cortex where executive function is thought to depend upon (Crews & Boettiger, 2009; Strenziok et al., 2011).

Nonetheless, this subsection has detailed and demonstrated that there is no known single cortical location directly identified as the ‘source of aggression’ and evidence has pointed towards a multisystem model of emotion that envelops many structures not just that of the limbic system or parietal lobe

(Brazdil et al., 2009). This has been supported by numerous investigations using haemodynamic and electrophysiological methods that have identified several areas of interest across frontal, central, parietal and temporal lobes.

1.5 Electrophysiological Indices of Aggression and Media Relation

As previously suggested, both haemodynamic and electrophysical measurements tools have been extensively used within the media research field. Electroencephalographical techniques have provided a cost beneficial (in comparison to fMRI methods), non-invasive and accurate tool for indexing cortical processing. However, they have been relatively underutilised in the media research field. In comparison to neuroimaging techniques, EEG provides a high temporal resolution but low spatial resolution thus, can accurately distinguish electrical responses and dynamic changes in electrical activity across cortical networks. However, the method cannot pinpoint the exact neural structures that are activated, across time (Luck, 2014) (see chapter 2 for further methodology discussion).

Innovative research has shown that scalp-recorded ERPs vary with perceived emotionality and intensity of presented stimuli (e.g. positive; negative; neutral) and across varying stimuli content (e.g. violent, erotic, disgust and neutral) (Codispoti, Farrari, & Bradley, 2007; Lithari et al., 2010; Schupp et al., 2000; Schupp et al., 2003; Schupp, Junghofer, et al., 2004; Weinberg & Hajcak, 2010). Typically, the first 50 ms post stimuli presentation of any given ERP waveform is thought to index basic brainstem activity. Olofsson, Nordin, Sequeira, and Polich (2008) suggested that early latencies (<100ms post stimuli presentation) could be related to visual and sensory processing, mid-latencies (200-300ms post stimuli presentation) could show early discriminatory and response processing and later latencies (post 300ms) could be associated with emotional reactivity and motivation.

It has been hypothesised that initial memory storage processes take place from 300ms post stimuli presentation (Schupp et al, 2003). The Late Positive Potential (LPP, a slow positive wave emerging between 400ms – 800 milli-seconds (ms) post stimuli presentation) has been linked with memory and encoding processing (Keil et al., 2002; Olofsson et al., 2008; Schupp et al., 2000; Schupp et al., 2003) and has been suggested to reflect an increased processing resource allocation based on the subjective perception of the emotive value of any given stimuli (Hajcak, MacNamara, & Olvet, 2010).

The processing of visual stimuli predominantly occurs between 100ms and 800ms post presentation (Fido, 2015; Luck, 2014b) and components such as the N100, P100, N170, N200, P200, P300 and LPP have been shown to be sensitive towards the processing of emotive stimuli (E. Y. Kim et al., 2013; Schupp, Cuthbert, et al., 2004; Schupp et al., 2003; Schupp, Junghofer, et al., 2004; Wiens, Sand, & Olofsson, 2011). However, there has been a contrast between the extent of investigation involved in spatial localisation (e.g. fMRI) of the emotional processing process in comparison to temporal dynamic assessment (Ding, Li, Wang, & Luo, 2017; Luck, 2014b; Schupp et al., 2003).

One influential EEG study conducted by Engelhardt, Bartholow, Kerr, et al. (2011) suggested that increased aggression could be predicted via the measurement of event related potentials (ERPs). This proposal was based on the theory that the P300 component was a neural marker of processing and decision making, especially in the parietal lobe. Both Engelhardt et al., (2011) and Bartholow, et al., (2006) proposed that ERP measurement could be used to measure desensitisation towards media violence. Typically, presented negative visual stimuli (e.g. VM and EM) evoke larger P300 components and Godleski et al. (2010) suggested that this surge of electrical activation was illustrative of an increased cognitive load and increased attention towards salient stimuli. However, Engelhardt et al. (2011) surmised that a reduced P300 post VVG exposure showed a desensitisation effect towards violent content. There has been support for this effect (Bailey, West, & Anderson, 2011; Bartholow et al., 2006) and these have all been foundational research that has influenced continued theorization (Groves & Anderson, 2015a, 2015b; Groves et al., 2016) and investigation (Liu et al., 2015; Mrug, Madan, & Windle, 2016; Szycik et al., 2017).

However, both the foundational and subsequent research have raised concerns regarding methodological, data processing, statistical issues and a lack of adequate justification for steps taken. For instance, some researchers measured ERP’s in relation to presented visual stimuli (e.g. Bartholow et al., 2006; Engelhardt et al, 2011). These stimuli were images provided from the International Affective Picturing System (IAPS, Lang et al., 1997) (see chapter 2 for further discussion), displayed in a standard oddball paradigm and participants were required to think about their reactions towards the images (e.g. Engelhardt, et al,.2011). Thus, potentially this evoked a primed response. Leading EEG methodologists (e.g. Luck, 2005; 2014) have suggested that the measure of ERP activation in response to the stimuli, via this method, could have been greatly confounded by activation related to the decision-making process. Thus, findings should be viewed with caution.

Further confounding variability has been shown where the oddball paradigm has been employed that, whilst recording EEG, requires participants to push a button as part of their response (e.g. Kim et al., 2013; Liu, et al., 2015). The physical movement of the hand and the associated brain activation required to complete the several activities would be so entwined that it would be impossible to differentiate response toward image from the cognitive process of reaching for the correct button, mentally checking it is the correct choice, visually checking the button is the correct choice and physically applying the force required. Most importantly, it would be quite improbable that the confounding effects of these several processes could be disentwined via any form of data filtering processes currently available (Luck, 2014).

Additionally, the use of unbalanced stimuli can negate probability and priming effects (e.g. Luck, 2014) (see subsection 2.2.17.1 for clarification). Engelhardt et al., (2011) used 35 images; 4 context images (neutral) and 1 target image (violent) across 2 blocks of 48 trials. Thus, across the trails and blocks, each neutral and violent image were repeatedly presented. This had a potential to skew the results towards one specific image category either by preparatory (i.e. target sequence history), probability effects or due to habituation/fatigue (Anokhin et al., 2006).

The P300 amplitude is affected by both global and local probability (Squires, Wickens, Squires, & Donchin, 1976). Thus, meaning that the P300 amplitude is influenced by expectations elicited by both overall content and recent stimuli sequence. Duncan-Johnson and Donchin (1977) stated that P300 amplitude was related to the probability of a rare (target) image when using the oddball paradigm. This is especially true for the posterior P3b component that has been related to the element of surprise and implicated in the indexing of the several operations of an adaptive brain system that permits the ability to predict events (Seer, Lange, Boos, Dengler, & Kopp, 2016). For example, an increased P300 response towards a target stimuli has been repeatedly found when the previous sequence was non-target stimuli in comparison to target stimuli (Nieuwenhuis, Aston-Jones, & Cohen, 2005). Additional investigation has suggested that this relationship is also dependent on the probability of the perception of the stimuli global content and subjective significance of the content (Nieuwenhuis et al., 2005; Schupp, Cuthbert, et al., 2004). Thus, due to the lack of perceived clarity and transparency, the desensitisation effect or reduced P300 for violent images for those that Engelhardt et al, (2011) viewed as aggressive, could be easily explained as effects of fatigue (there was a lack of stimuli rarity to produce the usual increased P300 effect) or probability effects.

Finally, Engelhardt et al. (2011) stated that there were 55 undisclosed images used. It is not clear where these images were used in the experimental procedure or paradigm, or what content or context they had. Therefore, this potentially led to further confounding variability (e.g. priming effects or an influential probability effect). The replicability of such influential research would be both academically questionable and physically not applicable. However, empirically rediscovering the foundational steps this research aimed to provide could invariably begin to build a clear picture of the media's effects.

In an attempt to justify and support the findings of a desensitisation effect in excessive VVG users, Szycik et al., (2017) conducted fMRI reseach using highly emotive salient images as stimuli and stated that, even after relaxing the standard statisitical controls, there was no evidence in support of a desensitisation effect. It was stated that the previously highlighted experimental design issues may have been responsible for the results and could have impeded true effects. It should be acknowledged however, that the sample only consisted of male participants and thus there were no across sex effects provided. Nonetheless, research investigating habituation towards EM in high exposure hypersexual participants similarly found no habituation effect towards EM (Steele, Staley, Fong, & Prause, 2013). On the contrary, results demonstrated increased P300 amplitude for EM in comparison to neutral stimuli and concluded that this clearly demonstrated that sexual desire was related to neurological response rather than modulated by hypersexuality or increase EM exposure (Steele et al., 2013).

Although media research that has used EEG methods has tended to focus on just one component: the P300 (e.g. Engelhardt, 2011) as a neural marker for aggression, alternative perspectives have questioned its applicability (e.g. Ramos, Ferguson, Frailing & Romer-Ramirez, 2013). Robust EEG research has demonstrated that processing visual media content takes place both pre and post 300ms stimuli presentation (e. g. Lithari, et al, 2010) and importantly, encoding, memory storage and an increased allocation of processing resources based on subjective perception of stimuli emotive value (Hajcak et al., 2010), which could further illuminate the cognitive basis of aggression and the reliance on the effects of the media for future behavioural cues, have been directly linked with the LPP response (Keil et al., 2002; Olofsson et al., 2008; Schupp et al., 2000; Schupp et al., 2003; Wiens, Sand, & Olofsson, 2011). Thus, investigations across this thesis have taken measurements throughout one second post stimuli presentation in order to encapsulate several ERP components (i.e. N100; P200; N200; P300; LPP) and the relative timeframes (i.e. 100ms; 200ms; 300 and 400-

800ms post stimuli presentation) most closely associated with processing of imagery in order to accurately begin disentwining the media effects without prior assumptions regarding neurological markers of aggression (e.g. P300 in the parietal lobe).

1.5.1 Sex Differences

There has been evidence of numerous sex influences on brain anatomy, chemistry and function (Cahill, 2006) with long established sex differences found across neuroimaging research (Filkowski et al., 2017; Ruigrok et al., 2014; J. S. Stevens & Hamann, 2012), EEG research (Gasbarri et al., 2007; Kemp, Silberstein, Armstrong, & Nathan, 2004; Lithari et al., 2010; Rupp & Wallen, 2008) and also in aggressive behaviour (ONS, 2016; Warburton & Anderson, 2015). As previously highlighted, theoretical positions (e.g. the GAM; CMoA; IEM; CM) have all identified sex as an important factor within their frameworks (Bartholow & Anderson, 2002) and violent crime rates have reflected this sex divide (see Ch 1.1). Males are more likely to be the victim (except from in sexual violence cases) and to be the physically aggressive perpetrator of violent crime (ONS, 2016; Warburton & Anderson, 2015).

In addition, research has shown males consume more VM than females, especially videogames and films (Chrisler & McCreary, 2010; Padilla-Walker, Nelson, Carroll, & Jensen, 2010; Phan, Jardina, & Hoyle, 2012; Winn & Heeter, 2009) and males have tended to outnumber females 2:1 for EM consumption, although, recently females have begun to narrow the gap (DasGupta, 2017). Despite the evident cross sectional sex differences in aggressive behaviours, consumption rates, neuroimaging research, structural evidence and ERPs response in relation to VM and EM, some research has treated sex as homogeneous (e.g. Bartholow et al., 2006; Bartholow, Sestir, & Davis, 2005) or omitted sex as a variable (Engelhardt, Bartholow, & Saults, 2011). Thus, missing the potential effects of sex and importantly, may have overstated or diluted the true effects of VM or EM across either sex irrespective of other contributing factors.

There has been very little published research investigating the effects of sex on ERP amplitude in relation to aggression or negative (e.g. VM) or positive stimuli (e.g. EM) (Olofsson et al., 2008). Although, where available, results have shown clear, significant differences between sex (e.g. Gardener; Glaser, 2012; Li, Yuan & Lin, 2008; Lithari et al 2009; Lusk, Carr, Ranson & Felmingham, 2017). Early component amplitudes (e.g. N100 and N200) have been found to be significantly increased for females in comparison to males (Lithari et al., 2010; Lusk, Carr, Ranson, & Felmingham, 2017).

Li et al. (2008) stated that although both sexes demonstrated an increased N200 and P300 amplitude towards negative images, there were significantly increased N200 and P300 amplitudes recorded for females when viewing moderately negative imagery in comparison to neutral. It was suggested that females have an advantage in emotion recognition that may result from the attenuated sensitivity in early processing. Likewise, Lithari et al., (2010) showed significant sex differences in emotional processing. Females demonstrated an increased early negative ERP amplitude for the N100 and N200 across differing media content and measurement locations (i.e. frontal (Fz), central (Cz) and parietal (Pz) lobes). This was consistent with the proposed female negativity bias that suggested females respond faster and with increased negativity towards biologically salient stimuli in comparison to males (Lithari et al., 2010). However, van Hooff, Crawford, and van Vugt (2011) showed comparative P200 ERP amplitude towards faces differentiated by attractiveness between females and males, it was demonstrated that males, not females, showed significantly increased post 200ms activation consistent with heightened processing and motivated attention. Further adding to the suggestion that sex differences likely reflect attention towards sex specific biological drives and stimuli content.

Support for the negativity bias was provided by Gardener, Carr, Macgregor, and Felmingham (2013) and Han, Fan and Mao (2008) who found marked sex differences in emotional regulation however, this phenomena was shown across both early (N100, N200) and late ERP components. Gardener et al., (2013) suggested that the female early negativity could be explained due to females having an increased up-regulation of emotional response.

Stevens and Hamann (2012) conducted an extensive meta-analysis of neuroimaging research and found support for the comprehensive sex differences in emotional response and perception although there were marked differences between negative and positive emotion targeting research. Where the female response was found to be increased, it tended to be in response to negative emotive stimuli (i.e. VM) and where males were favoured, it tended to be in response to positive stimuli (i.e. EM). Overall, it was suggested that the meta-analysis findings indicated that the amygdala demonstrates valence-dependent sex differences in BOLD activation in response to emotional stimuli and highlighted the key importance of considering sex as a modulating factor in emotional processing of different types of media.

As previously stated, interest and response to visual sexual stimuli has been found to favour males in comparison to females (e.g. Hamann, Herman, Nolan and Wallen, 2004) . Lykins, Meana, and Strauss (2008) investigated attentional sex differences towards EM and found that focus for both sexes was directed at figures rather than faces or scenes. However, Rupp and Wallen (2006) found that females using oral contraceptives tended to focus on background scenery more than male participants who tended to focus on the figures and faces of the opposite sex.

There has been a mounting selection of supporting evidence showing how hormonal changes across the menstrual cycle modulate and moderate neurological activation (Krug, Plihal, Fehm, & Born, 2000; Lusk et al., 2017; Rupp & Wallen, 2008; van Lankveld & Smulders, 2008; Wallen & Rupp, 2010). Krug et al. (2000) demonstrated significant differences in both the P300 (Fz site) an LPP (Cz Site) ERP component amplitude between EM (nude males) and neutral images for healthy premenopausal females. Females in the ovulatory phase were found to respond with an increased ERP amplitude in the frontal, Fz site (see chapter 2.2.2 and 2.2.6 for clarification of site locations) across the P300 however, demonstrated a reduced response during both other menstrual phases.

This was supported by recent research that demonstrated females in the midluteal phase showed a decreased ability to suppress cortical processing of negative stimuli in comparison to males (Lusk et al., 2017). This was substantiated by an increased N200 response for females in comparison to males and it was concluded that females may show deficits in the down regulation of both neural and behavioural response. Thus, suggesting that typical fluctuating hormone balance has an influence on processing and response toward affective stimuli (Rupp and Wallen, 2006; 2010) and has demonstrated that there are evident sex differences in neurological response towards differing media content (see subsection 1.5.2. Media Content) and the impact of sex should be considered when investigating the effects of the media.

Due to the considerable variations in findings, the focus of the initial experimental chapters (see Chapter 3 & 4) was to explore ERP amplitudes across N100, N200, P300 and LPP epochs whilst considering the effects of alternative variables including sex. This was understood to establish foundational baseline results that could be built upon for future investigation.

1.5.2 Media Content

Both VM and EM content have been implicated as causal of detrimental changes in the brain and behaviour (Anderson & Bushman, 2001; Engelhardt, Bartholow, Kerr, & Bushman, 2011; Huesmann, 2010; Malamuth, 1986; Malamuth, Addison, & Koss, 2000; Malamuth, Hald, & Koss, 2012) and although there has been some convergence across concluding commentary regarding responses toward emotive stimuli, findings have yet to provide any conclusive evidence of assumed causality. This may be attributed to the variance across stimuli and measures (e.g. aggression and EEG location; component; data extraction and analysis method) used and the lack of replicability across research.

Exploration to evoke an emotional response have employed a wealth of differing stimuli for example, films (Chivers, Seto, & Blanchard, 2007; Fernandez et al., 2012; Gasbarri et al., 2007; Oliver, 2014), emotional words (Bertsch, Bohnke, Kruk, & Naumann, 2009; Imbir, Jarymowicz, Spustek, Kus, & Zygierewicz, 2015), images (Carretié, Mercado, Tapia, & Hinojosa, 2001; Codispoti, De Cesarei, Biondi, & Ferrari, 2016; Foti & Hajcak, 2008; Lithari et al., 2010; Polackova & Lacev, 2017; Prause, Steele, Staley, & Sabatinelli, 2015; Prause, Steele, Staley, Sabatinelli, & Hajcak, 2015; Versace, Bradley, & Lang, 2010; Wiens et al., 2011) and specific image content (e.g., emotional faces / figures) (Meaux, Roux, & Batty, 2014; Mocaiber et al., 2010; Nordström & Wiens, 2012; Norman, Tepe, Nyhus, & Curran, 2008). Although both films and emotional words could be used to record related responses, it would be difficult to separate the responses to specific elements of films as these would likely overlap due to the consistently changing stimuli content. Similarly, the use of emotive words would entail attempting to disentangle the response to verbal information and word perception (Lithari et al., 2010). Based on this, still, full colour imagery was deemed suitable for the requirements of the current research as they enabled the content to be kept real-life and reduced the potential of cross over effects in responses evoked from consistently changing visual stimuli (e.g. videogames or films).

It has been accepted that evolutionary processing (fight, flight and reproduction) has played an important shaping effect on how humans rapidly process complex scenes. Due to this shaping, humans have excellent discriminatory judgement over threatening; erotic or disgusting depictions (e.g. evolutionary-related implicit attention or emotional attention (see Schupp et al., 2003)). It has been speculated that this ability is essential to assess immediate threat and for the protection of offspring and could explain the increased ERP responses that have been found toward emotional stimuli, across post stimuli millisecond time intervals (Gur, Gunning-Dixon, Bilker, &

Gur, 2002; E. Y. Kim et al., 2013; Schupp et al., 2003; Schupp, Junghofer, et al., 2004; Weinberg & Hajcak, 2010; Wheaton et al., 2013; X. Zhang, Guo, Zhang, Lou, & Ding, 2015). In conjunction, Ramos, Ferguson, Frailing, and Romero-Ramirez (2013) stated that individuals elicited increased neurological activation to media content understood to be real rather than faked or posed. Therefore, using fantasy-based stimuli (e.g. videogames; images of faked poses; or set up scenes) may not elicit true effects. It has been argued that the use of real-world relevant visual stimuli (in comparison to abstract, posed, fantasy or colour swatches) would increase understanding of real-world prioritised processing (Anokhin et al., 2006).

When using images as stimuli, there has been a tendency to select them based on their valence or arousal ratings (e.g. Alpers, 2008; Alpers, Adolph, & Pauli, 2011; Bartholow et al., 2006; Kunaharan, Halpin, Sitharthan, Bosshard, & Walla, 2017; Lang et al., 2008; Lithari et al., 2010; Polackova S. & Lacev, 2017; Zheng et al., 2015). Using this method has aided researchers to actively select and determine images for category placement and categorisation (pleasant or non-pleasant). However, Anokhin et al. (2006) suggested that using stimuli that were directly relevant and specific to the category content (e.g. violent or erotic) would be more beneficial when attempting to make references about, for example, real-world effects of differing types of media content.

In addition, categories of images selected based on their arousal and valence ratings have led some media researchers to collate groups of negative stimuli with mixed content (e.g. disgust and violence) (e.g. Engelhardt et al, 2011). Stimuli depicting disgust related content (e.g. bodies with infectious disease, parasitic infestations or the mutilated and rotting corpse of a dog) has shown differences in cortical activation in comparison to other emotional content such as VM (Schienle, Schafer, Stark, Walter, & Vaitl, 2005). Although the disgust emotion was thought to have originated as a rejection towards toxic substances (e.g. core disgust), societal evolution has expanded this emotion to include moral disgust with typical triggers such as sexual immorality (incest, paedophilia, masturbation, rape) and non-sexual immorality (e.g. theft, homicide) (X. Zhang et al., 2015). Therefore, it appears paramount to consider media content more closely than just valence or arousal dependant.

For example, recent research investigating the physiology in trypophobia (aversion to clusters of holes) suggested that despite the apparent similarities between fearful (i.e. snakes or fear of physical threat) images that would require an urgent response (i.e. fight or flight) trypophobia due to the holes appearing as, for example, snake skin patterns, findings suggested that aversion to holes was more associated with reactions consistent with disgust. Therefore, this has suggested that there may be differences between fear and aversion that could be a result of the involvement of the parasympathetic nervous system in response towards images of disgust/ aversion (Ayzenberg, Hickey, & Lourenco, 2018) in comparison to responses towards a direct life threatening stimuli such as a snake or VM (e.g. a weapon being held at an opponent). Thus, it was imperative that stimuli used across this thesis were category and content specific.

Traditionally, media research has found differences in ERP response towards differing imagery content (e.g. neutral, violent, erotic, disgust) (Lithari et al., 2010; Luck, 2014b). Some have examined the differences between a baseline (e.g. neutral content) and emotive stimuli (Codispoti et al., 2007; Coyne et al., 2008; Cuthbert et al., 2000; Keil et al., 2002; Kemp et al., 2004) and generally, findings have shown an increased ERP activation in response to image content considered either positively (i.e. EM) or negatively (i.e. VM or scenes of disgust) biologically relevant in comparison to neutral stimuli (Anokhin et al., 2006; Kunaharan & Walla, 2015; Schupp et al., 2000; Schupp et al., 2003; Schupp, Junghofer, et al., 2004),. Others have investigated between group (e.g. sex; media exposure groups; criminality) response towards different image categories (Bailey & West, 2013; Bailey et al., 2011; Bartholow et al., 2006; Lithari et al., 2010). However, to date, there has been no known empirical EEG research that has demonstrated any direct link between responses towards affective stimuli and trait aggression whilst taking consideration of some alternative, potentially defining factors of aggression.

Anterior activation between 200-600ms post stimuli presentation has shown selectivity for EM compared to VM or neutral content (Anokhin et al., 2006). Initially activation was recorded across frontal and central sites with subsequent onset in parietal sites. In summary, this was related to motivated attention as findings were the same irrespective of valance (pleasant, unpleasant, neutral) or arousal ratings. In general, emotive stimuli produces an early negative ERP amplitude across frontal sites that appears to move in a posterior fashion across the cortices, down the z line (luck, 2014) however, response to differing media content is a complex phenomenon. There are several factors that have been shown to potentially affect responses (e.g., participant age (Kensinger & Leclerc, 2009), race (Wiese, Kaufmann, & Schweinberger, 2014), image content such as faces (Fan et al., 2015) or figures (Nordström & Wiens, 2012) and stimuli colour (Cano, Class, & Polich, 2009)). For instance, although early processing found no role for colour in visual categorisation tasks (Delorme, Richard, & Fabre-Thorpe, 2010; Elder & Velisavljevic, 2009; Fabre-Thorpe, 2011) and no differences in accuracy or response speed during performance of go/no-go neutral scene tasks, an influence of colour was noted across later processing (e.g. post 300ms) timeframes (Cano et al., 2009; Fabre-Thorpe, 2011). However, colour has been shown to increase memory recognition by aiding encoding (Spence, Wong, Rusan, & Rastegar, 2006) which have been linked with LPP activation towards visual scenes (Olofsson et al., 2008).

There has been a plethora of research examining the processing of visual scenes inclusive of the presence of figures and faces (Nordstrom, et al. 2008). It was suggested that processing and attention is more directed towards stimuli with faces and figures than scenes (Clayson & Larson, 2013; Nordström & Wiens, 2012). The presence of a face evokes larger early ERP activation in comparison to scenes. The N170 component has been linked with the presence of a face in stimuli (Fan et al., 2015) and has been viewed as the indicator of facial recognition and face processing (Eimer, 2011; Luo, Feng, He, Wang, & Luo, 2010; Sel, Calvo-Merino, Tuettenberg, & Forster, 2015). Towler and Eimer (2015) found that simultaneous presentation of faces and non-face stimuli evoked the N170 component in the contralateral hemisphere to face image presentation. A reduced N170 component has been demonstrated in participants with face processing abnormalities in neurological and psychiatric disorders (Feuerriegel, Churches, Hofmann, & Keage, 2015). The authors deduced that these findings reflected the facial affect processing dysfunction and social impairments suffered by some with neurological and psychiatric conditions.

Victor, Drevets, Misaki, Bodurka, and Savitz (2017) used fMRI to compare both sexes on emotive facial images. Females showed greater BOLD activity in subgenual anterior cingulate cortex and right hippocampus in comparison to males during the viewing of sad, verses happy faces. Thus supporting claims that females have been shown to be more sensitive towards emotional content inclusive of facial expressions (Kret & De Gelder, 2012). Importantly, Alpers, Adolph, and Pauli (2011) found that there were significant differences in neurological response towards stimuli depicting scenes with faces present. Thus, it appears paramount that stimuli content is examined far more closely than just high and low rating values prior to the use within experimental paradigms as the above has demonstrated how imperative image content is on visual processing.

1.6 Chapter Summary

This chapter has discussed aggression and the proposed detrimental link with media exposure. It has been demonstrated that this relationship appears far from linear. Some unjustified theoretical assumptions have been made and questions have been left unanswered. There has been a mounting base of evidence suggesting that exposure to VM and EM has a negative impact on the brain and behaviour. However, there has been a myriad of competing evidence that has highlighted several failings within the field that when accounted for has provided results that either accept the null or show minimally significant findings with small effect sizes (Ferguson, 2010). Some of the highlighted issues were for example, but not limited to, the use of invalid measures of aggression; a failure to identify 'third variables' or recognise confounding variability and their effects; a research base demonstrated to be confounded with both citation and publication bias; the over inflation of findings based on small effect sizes; the use of measures without identified cut off values (e.g. aggression) and the unstandardized use of psychometric measurements tools (Ferguson, 2010; Ferguson & Dyke, 2012) which have potentially led to inflated causal claims and an apparent justified public and academic moral panic.

Contemporary EEG research has identified several important factors that could play key roles in response towards affective imagery. Specifically, the processing of image content (faces, figures, colour) rather than image category (violent, erotic, neutral) and valance or arousal ratings. It has been clearly demonstrated that sex must be included as an independent variable when investigating processing on differing content stimuli and aggression. Similarly, it has been suggested that previous life experiences (e.g. previous witness or victim to violent crime) and lifestyle choices (e.g. preference towards VM) could be indicative of the expected differences of ERP response that, could support or refute previous theory and research. These require further investigation using contemporary, unbiased and justified methodology.

Although media content has been shown to effect processing. There has been a paucity of EEG research investigating these effects and no currently known research looking specifically at the media effects, aggression and alternative factors. This research aimed to initially explore the findings when methodological issues were addressed (where possible), whilst using EEG measures without prejudice or fear of accepting the null. This research should help cement a theoretical model, provide a contemporary foundation and direct future research within the field.

1.7 Plan

Prior to the following experimental chapters, it appeared that there was no empirical research that had investigated the neurological foundations of aggression and sexual aggression in response to VM and EM, in relation to previous life experience and demographic information when using previously validated and contemporary measures. Past research and theory had identified and evidenced the importance of such research however, several key issues had been highlighted (see Ferguson, 2007; 2008; for an overview) that could have impacted on results and assumptions drawn from the data. Moreover, recently there had been paucity in investigations regarding the effects of previous life experiences, lifestyle choices and demographic information on types of aggression (e.g. trait and sexual). Research using hemodynamic and electro-physical techniques have shown effects on cortical activation whilst viewing affective images (e.g. Barthelow et al, 2006; Engelhardt et al., 2011; Lithari et al., 2010; Waismann et al, 2003) however, some of the technology previously employed had been superseded. Therefore, initial intentions were to use current technology, reassess the fundamental parameters of the research field, update previous methodological issues where appropriate and provide an unbiased empirical base to build upon in future research.

Study 1: We Are What We See? ERP's in response to Pornographic, Violent and Neutral Imagery

Initially, an exploratory investigation into the effects of alternative factors, such as sex or previous life experiences and choices on neurological response towards media of differing content has been provided within a pilot sized study. This study aimed to employ current methodologies, without bias or pre-existing assumptions of findings in order to genuinely explore, from a wide angled perspective, the horizon of the field rather than replicating findings that have been demonstrated to have potential flaws that invariably eluded true effects of VM and EM.

Study 2: Don't Look Now – It's a gory, violent bit! The Hot Collared, Angry & Gruesome Effects of the Media: ERP's in Response to Pornographic, Violent, Disgusting and Neutral Imagery

Based on study 1., this research attempted to clarify the importance of the findings in the pilot study and further refine the methodology and parameters of research using an increased participant sample.

Study 3: What Are You Looking At? The Highs and Lows of Aggression: Why standardisation would help.

This chapter aimed to dissect the differences between highly aggressive and low aggressive individuals to investigate the possibility of the state change / effects of media on neurological response. In addition, this chapter further highlighted the issues with unstandardized use of psychometric measurement tools; the lack of predefined cut off values when defining aggressive individuals and highlighted how the choices made regarding statistical analysis method could impact findings.

Study 4: Let's Rewind & Begin at the Beginning: What is Neutral?

In order to illuminate the relevance of the differences found in the previous chapters and highlight issues with research that used neutral images as a baseline in comparison to other affective imagery, it was considered imperative that there was an investigation conducted to understand what could be considered neutral.

1.8 Aims

This thesis has aimed to:

Explore differences across component encapsulated epochs in neurological response towards affect imagery of differing content (i.e. violent, erotic, disgust and neutral) whilst employing current best practices in EEG.

Explore some previously outlined alternative factors of aggression and investigate these in relation to the theoretical posits of the research field (e.g. Lifestyle choices/ experiences and demographic variables)

Explore a baseline measure (e.g. what is neutral content).

Advance understanding of image content with the development of neutral stimuli that could be used as an unbiased baseline measure and to adequately explore the viability of currently accepted stimuli.

Explore theoretical posits of response differences based on trait aggression scores and understand these in relation to theory

Explore the effects of differing trait aggression score data analysis methodology on overall differences between high and low groups.

Chapter 2 **Methodology**

All procedures that were undertaken for the purpose of this thesis were conducted in accordance with the British Psychological Society's regulations and ethical guidelines (BPS) (BPS, 2014) and gained approval from the Human and Health Sciences School Research Ethics Panel. Participation in all of the experimentation was voluntary. However, 1st and 2nd year Psychology students from the University of Huddersfield were allocated course credits for their contribution.

In order to investigate the effects of affective imagery on neurological response, electroencephalographic methods were employed. An overview of the EEG technology, recommended usage thereof and potential limitations of the method have been provided below. Study specific standard methodology sections have been provided within each subsequent experimental chapter. However, the following chapter was provided to avoid duplication of information across experimental chapters and to enable clarification and justification of points and methodological decisions made, where required.

2.1 Electroencephalographic Methods

Electroencephalography (EEG) is a non-invasive, cost effective and easily implemented, electrobiological imaging tool that has been widely adopted within both medical and research fields (Light et al., 2010; Teplan, 2002). EEG methodologies measure changes in electrical potentials triggered by a vast number of electric dipoles that are neuronally formed in response to excitation or inhibition (Kirschstein & Kohling, 2009). EEG technology allows for the measurement of summated synchronous neurophysiological activity and function (event related potentials (ERPs)) across the cortices and has provided temporally precise measurements of such activity during differing tasks and conditions (Carlson, 2010; Kirschstein & Kohling, 2009). Therefore, EEG measure reflects neural networks rather than specific brain structures (Luck, 2014b).

The biological basis of the fluctuations in cortical voltage (EEG and ERPs) has been a contention for discussion (Woodman, 2010). However, electrical potentials are formulated within the extracellular fluid as the transfer of ions (e.g. $Na+$, $K+$, $Ca++$, and $Cl-$) across cell membranes via sodium-potassium adenosine triphosphatase pumps ($Na+/K+$ -ATPase enzyme). The $Na+/K$ pumps (found within the plasma membrane of the neuron) transport sodium out of the cell and potassium onto the cell against their concentration gradients via voltage-gated ion channels. Sequential opening of the ion channels along sections of the neuron moves the action potential along the neuron. However, ERP's are predominantly originated as post synaptic potentials (PSP) that are produced when neurotransmitters bind to receptors (Buzsaki, Anastassiou, & Koch, 2012; Lopes da Silva, 2013; Woodman, 2010). This binding changes the flow of ions across the cell membrane and produces a minute flow of charge (electrical dipoles between the soma (body of neuron) and the apical dendrites (neural branches)) (Buzsaki et al., 2012; Lopes da Silva, 2013).

Neurons are interconnected in a net formation via synapses. Approximately 500 trillion synapses are present in the adult brain (although there is a negative relationship between age and number of neurons, there is an increase in number of synapses per neuron over time) (Teplan, 2002). The collective activation of neurons (approximately 107 billion, see Cooper et al., 1965; Woodman, 2010) that are positioned perpendicular to the neurocranium (and potentially facial bones), creates an electric field of a magnitude that can penetrate the brain, meninges, skull and skin layers and can be recorded by electrodes placed on the scalp (Buzsaki et al., 2012; Lopes da Silva, 2013; Woodman, 2010). These small current traces can be cancelled out if the neurons are not orientated together (Woodman, 2010). Pyramidal cells are the predominant source of recorded cortical activity, as they lie perpendicular to the scalp surface thus, the summated dipoles do not cancel one another out (Buzsaki et al., 2012; Kirschstein & Kohling, 2009; Lopes da Silva, 2013).

EEG techniques have been shown to be a favourable methodology for use in investigating and understanding the neural processing that occurs in complex high order cognitive and functional operations as they are relatively non-invasive and can provide an excellent temporal resolution in comparison to alternative methods such as both fMRI and PET. This is because they can be time-locked to within milliseconds of stimuli presentation (e.g. Luck, 2014b; Light et al., 2010). However, the method's main disadvantage is that both fMRI and PET methods surpass EEG methods for their spatial resolution (Luck, 2014b; Srinivasan, 1999). Even using a high number of recording electrodes, EEG methodology can offer no direct link between activation recorded and exact cortical structure or area that produced it. However, results from both hemodynamic and electrophysiological methods have been co-referenced and has begun to amalgamate the benefits of both (Brazdil et al., 2009; Woodman, 2010). Recently, there has been successful integration of peripheral physiological measures with brain activation methods (Bernat, Patrick, Benning, & Tellengen, 2006; Liu, Huang, McGinnis-Deweese, Keil, & Ding, 2012).

Due to the high temporal resolution, the EEG methodology provides a robust and dynamic tool for capturing and measuring stimuli-evoked event related potential (ERP) emotional and attentional processing across time (Codispoti et al., 2007; Ding et al., 2017; Hajcak et al., 2010; Sur & Sinha, 2009). The first 50ms of an ERP waveform has been thought to refer to brainstem activity with other very early wave components that peak within the first 75 milliseconds (ms) being referred to as sensory or exogenous and are dependent on objective properties of the stimuli. Components peaking post 75-100ms are termed endogenous and refer to the cognitive element or the processing of the stimuli (Sur & Sinha, 2009). The majority of conscious processing toward visual stimuli occurs between 100 and 800ms. Primitive processing and automatic responses can be viewed at approximately 100 – 300 ms and post 300 ms is thought to refer to higher cognitive processing. There are several components that have been identified (e.g. Sur & Sinha, 2009), however only those related to this research will be discussed.

The N100 or N1 wave is a negative deflection that peaks at approximately 100ms post stimuli onset. It is usually at maximum amplitude over the Cz electrode that is located at the centered position between the nasion-to-inion and the preauricular-to-preauricular points (see section 2.2.2 and 2.2.6 for description of electrode site and figure 6. for visual representation). The P200 or P2 wave is a positive deflection that peaks at approximately 200ms post stimuli presentation over the frontiocentral areas (e.g. Fz, Fcz) and has been viewed as reference between ambiguity and risk of a task (Lei, Jiehui, & Qiang, 2014) and sensation-seeking behaviour (Sur & Sinha, 2009). There are three components to the N200 or N2 waveform; the N2a (also known as the "mismatch negativity" (MMN)), N2b and the N2c. All three components peak at approximately 200ms post presentation and are negative wave deflections. It has been suggested that the N200 is relative to automatic encoding processes (Sur & Sinha, 2009). There have been sex differences found in early responses such as those across the 100 and 200ms post stimuli presentation timeframes (Gardener et al., 2013; Lithari et al., 2010). These findings, among others, have provided strong indication that males and females process visual stimuli differently.

The P300 or P3 is the component that the majority of research (both internal and external to the thesis field) has focused upon (Bartholow et al., 2006; Bistricky, Atchley, Ingram, & O'Hare, 2014; Cano et al., 2009; Gasbarri et al., 2007; Kent Kiehl, Hare, Liddle, & McDonald, 1999; Kim et al., 2013; Li et al., 2008; Schupp et al., 2003; Smith & Waterman, 2003; Zheng et al., 2015). It is a positive deflection that peaks between 250ms and 400ms and has several elements that are thought to reflect information processing that has a direct relation to attention and memory mechanisms (Polich, 2007). Increased attention has produced increased P300 amplitudes and it has been suggested that a reduced P300 amplitude may be an indicator of the neurobiology that reflects a vast array of disorders that are underpinned, or externalised, in substance dependence and antisocial behaviour (e.g. Patrick et al., 2006).

The late positive potential (LPP) is typically observed between 450ms and 1000ms and there has been a vast exploration of its indicative function on emotional process (Olofsson et al., 2008). It has been found that emotive images elicit an increased LPP amplitude than those measured in response to neutral images in both adult (Foti & Hajcak, 2008; Moser, Hajcak, Bukay, & Simons, 2006; Schupp et al., 2003) and child populations (Hua et al., 2014; Kujawa, Klein, & Hajcak, 2012).

2.2 Participation, and Overview of the Experimental Procedure

Within each experimental chapter, the methodology and procedures were similar. Participants were asked to complete any questionnaires prior to arrival at the laboratory. The questionnaires were provided online and were specific to the research requirements. The participants were introduced to the laboratory and re-briefed on the experiment and their right to withdraw. The participant's head circumference was measured to ensure correct cap sizing. The 256-channel dense array EEG net was submerged in deionised water with 10ml of baby shampoo to help reduce any effect of naturally occurring oils and 10g of potassium chloride to maximize conductance at the electrodes. A measurement across the nasion line and the preauricular line were taken to define the vertex (reference point) and marked on participant's head. Standardised location layout on the 10 – 20 electrode montage as illustrated by Malmivuo and Plonsey (1995) has been provided for visual comparison between the locations used (Fz, Fcz, Cz and Pz) on the standardised net layout and the clustered electrodes selected for those locations (see Figure 6 and Table 1.). Net application was carried out as per manufacturer's guidelines.

Participants were directed behind the dividing screen and seated in front of the computer monitor where the images would be displayed. The net was connected to the amplifier. Participants were informed that the lighting would be dimmed and that during the experiment, they were required to passively observe the images whilst remaining as still as possible to eliminate additional muscular and ocular interference. Participants were advised that the researcher would be sat on the opposite side of the screen and would stop the experiment at any time if requested to do so, in line with the ethical guidelines (BPS, 2014).

The stimuli were displayed on a 19inch monitor for 1000ms and replaced by an inter-stimulus crosshair screen for 1000ms. However, there was a random inter-trial temporal jitter introduced of 0s - ±100ms pre-stimulus presentation as recommended in contemporary research (e.g. Keil et al. 2014: Luck, 2010). It should be acknowledged that although this appears as a continuous time window, due to the refresh rate of visual monitor screens (60hz), there were only certain time frames the jitter would occur (e.g. multiples of 16.667, hence 16.667ms; 33.334ms) however, this was not visible to the naked eye (Lyes, 2011; Zaperty, Kozacki, & Kujawinska, 2014). The jitter was used to ensure that the neurological response recorded was not attributed, or time locked, to the expectance or prediction of the stimuli (Woodman, 2010). This method has been considered advantageous and has been used within the field previously (overview provided in Luck, 2014b). The images were presented in a random order and ERP's were recorded in response. This method has also been shown to reduce detection of secondary processes (i.e. intentional suppression of sexual motor processes or sustained attention) in comparison to block design presentation (Bühler, Vollstädt-Klein, Klemen, & Smolka, 2008)

Upon completion, the net was carefully removed, disinfected with germicide 3 and rinsed, in line with the manufacturer's guidelines (see Appendices I.). The participants were then fully debriefed and thanked for their participation in accordance with BPS (2010) guidelines. Contact and support details were also supplied (see Appendices J). The room temperature was controlled throughout experiments.

Post experimentation, the software package (Netstation 4.5 from Electrical Geodesics, Incorporated (EGI)) was used to conduct the processing and extraction of ERP data. In order to ensure that the data was robust, valid and of the highest quality, the manufactures technical manual and guidelines were followed and re-evaluated in line with relevant research and recommendation (Cassidy, Robertson, & O'Connell, 2012; Delorme et al., 2011; Ferree, 2006; Field, 2013; Huang & Federmeier, 2015; Huffmeijer, Bakermans-Kranenburg, Alink, & van Ijzendoorn, 2014; Indira, Vasanthakumari, & Sugumaran, 2012; Kappenman & Luck, 2016; Landa, Krpoun, Kolarova, & Kasparek, 2014; Lazarev, 1998, 2006; Leonard, Lopez-Calderon, Kreither, & Luck, 2013; Light et al., 2010; Luck, 2014b; Luck &

Gaspelin, 2017, in press; Maess, Schroger, & Widmann, 2016; Srinivasan, Tucker, & Murias, 1998a, 1998b; Tanner, Norton, Morgan-Short, & Luck, 2016; Wallstrom, Kass, Miller, Cohn, & Fox, 2004; Widmann, Schroger, & Maess, 2015; Woodman, 2010; Yao, 2001; Zoumpoulaki, Alsufyani, & Bowman, 2014).

Participation in any of the experimental studies required participants to have normal to corrected vision and to practice complete personal abstinence from drugs (both prescription and recreational) that could influence their brain activation or day to day functioning and act as a confounding variable within the research e.g. antipsychotic medications. There has been extensive previous research that showed the effects of narcotics on EEG recording (Abraham & Hopkins Duffy, 2001; Billard, Gambus, Chanmoun, Stanski, & Shafer, 1997; Billard & Shafer, 1995; Ceballos, Bauer, & Houston, 2009; Hoffman, Keppel Hesselink, & de Silveira Barbosa, 2001; Norman et al., 2008; Paul-David, Riehl, & Unna, 1960; Saito et al., 1997) therefore, the aim was to ensure that responses recorded were in relation to the image content rather than a narcotic effect.

ERP’s were averaged together to produce grand ERPS for each participant. The use of mean grand averaged data has been preferred over peak amplitude data due to inaccuracies that can occur during the analysis when using peak amplitude only (Luck, 2014b; Luck & Gaspelin, 2017) (see chapter 2.2.7 for further discussion). These were then average referenced to account for the convoluted surface of the brain (see 2.2.15). Offline software packages (Microsoft Excel and SPSS) were used to transpose and analyse the data on a Windows operating system.

2.2.1 Laboratory Layout and Apparatus Specifics

All data was recorded within a predesigned EEG laboratory at The University of Huddersfield. The floor plan has been provided (see Figure 5.) whereby it is evident where all tasks such as net preparation / disinfection and application were conducted in respect to the experimental task(s).

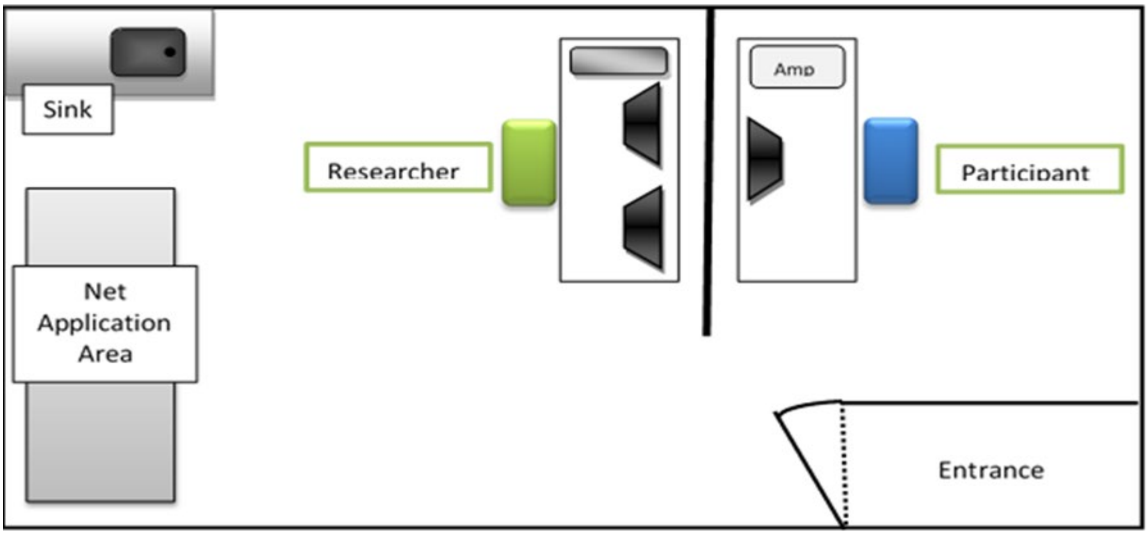


Figure 5. Visual representation of the laboratory layout.

Sink Area

In this area, there was storage of the deionised water, the baby shampoo and the potassium chloride that were used to soak the hydrocel geodesic dense array nets in prior to application. Germicide 3 was used to disinfect the net post use and was also stored in this area.

Net Application Area

The different sized 256 channel nets were placed in this area between uses. There were three different sized nets used throughout the experiments; small (54cm – 56cm), medium (56cm – 58cm) and large (58cm – 61cm). For application and removal, participants were seated within the vicinity.

Researcher and Participant Workstations

The 256 channel dense array EEG measurement nets were used to record ERPs. The nets were attached to the amplifier that was positioned at the participant area. ERP's were recorded using the Netstation Dense Array EEG Workstation software that was run on an Apple Mac Pro (version 10.6.8) located at the Researcher area. This system was clock synchronized to a desktop PC running Windows XP (P2.66Ghz Quadcore Intel Xeon, 3Gs 10.66MHz DDR3), which was used to run the EPRIME software and was located at the Participant area. This software randomized and generated the images (see Ch 2.2.17) that were displayed on a 19inch monitor placed in the participant area.

All equipment complied with safety regulations (see Appendices A, B, C and D).

External Apparatus

Where participants were required to complete questionnaires (see Ch2.3) prior to experimental participation, the process was conducted online using a platform purchased by the university named Qualtrics. One of the benefits of using this method was that data was encrypted and stored externally without any personal information from the participant. Only specific codes could link a participant number to their data. The questionnaires used were a demographic questionnaire that requested information on lifestyle choices and previous experiences (see Appendices E) and the Buss & Perry (1992) Aggression Questionnaire. This questionnaire was viewed as the gold standard across psychometric measures of aggression (Gerevich et al., 2007).

For data transposition and analysis, two external programmes were used; Microsoft Excel and IBM SPSS v 22 respectively. These programmes were run on an offline laptop (HP Elitebook Intel® Core ™ i7, 8Gb 2.67GHz) that required fingerprint recognition and programme specific password protection. Additionally, it had full disk encryption and filesystem-level encryption in order to guard information in line with ethical guidelines.

2.2.2 Geodesic Dense Array Nets

Data was recorded using 256 channel geodesic dense array nets. The equidistant scalp distribution of the electrodes has been provided in Figure 7. Throughout all of the experimental chapters, the same clusters of electrodes formed the locations (see Table 1 and Figure 7) Pz, Cz, Fcz, Fz, T7 and T8 that were comparative with the distribution on the 10-20 electrode placement system that were standardised in 1958 by the International Federation in Electroencephalography and Clinical Neurophysiology (Jasper, 1958) and have been extensively used in previous research (e.g. see Luck, 2014b). The 10-20 distribution has proportional percentage distances between the electrodes (see figure 6.) (Malmivuo and Plonsey (1995)) and the electrode sites are labelled in line with the adjacent cortical area; F (frontal), C (central), T (temporal), P (posterior), and O (occipital). The letters are followed by a number; odd numbers are situated on the left hemisphere and even numbers are those placed over the right hemisphere. However, the high-density, equidistant electrode locations are simply numbered up to 256 (see Figure 7 & 8.)

Although the high-density nets that were used were medical grade, there was no accuracy superiority using 256 channels in comparison to that of either 126 or 64 channel nets, as the locations extracted were standard. However, research has suggested that a minimum of 126 channels should be used in order to adequately sample the human cortex (Srinivasan et al., 1998b), and for extraction of topographic or source location data and imaging, the maximum available recording electrodes should be utilised to reduce error (e.g. see Luck, 2014b). Therefore, 256 channel geodesic nets where used and the clustering of the electrodes for analysis averaged the ERP's over several recording sites hence, this method reduced potential spikes in voltage at any one electrode and potentially reduced error produced within the interpolation algorithms (Luck, 2014b; Woodman, 2010). During all experiments, electrode impedance rates were held at less than 5 ohms.

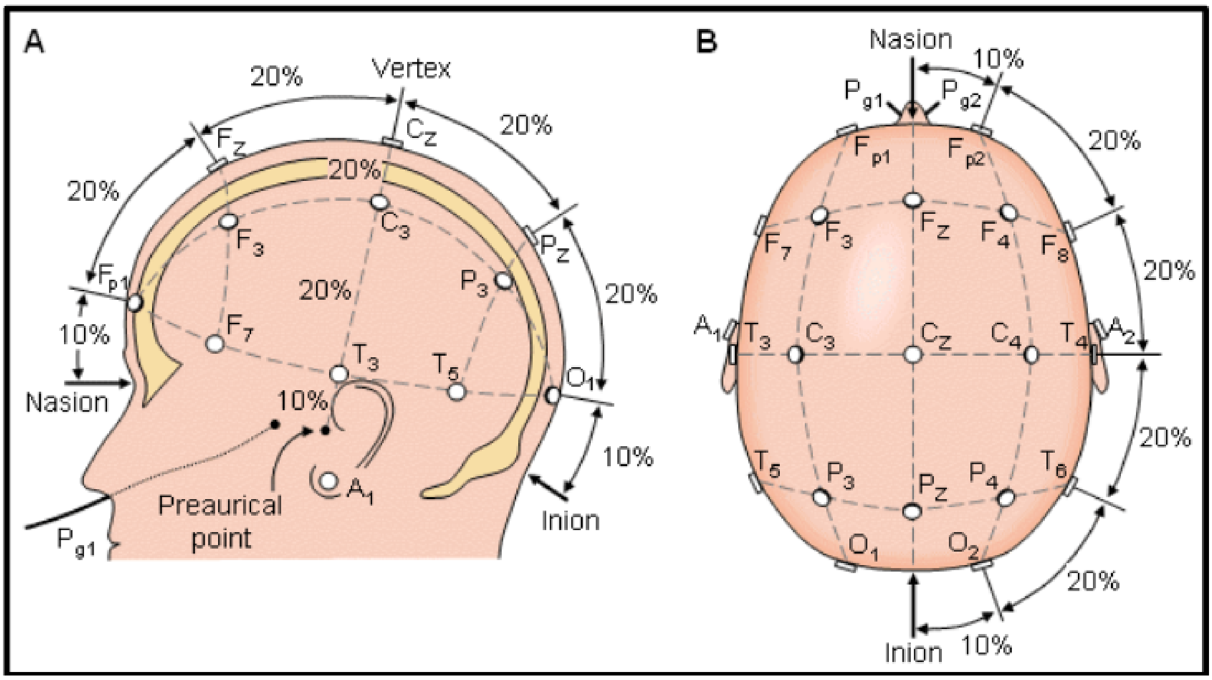


Figure 6. Standardised location layout on the 10 – 20 electrode montage as illustrated by Malmivuo and Plonsey (1995).

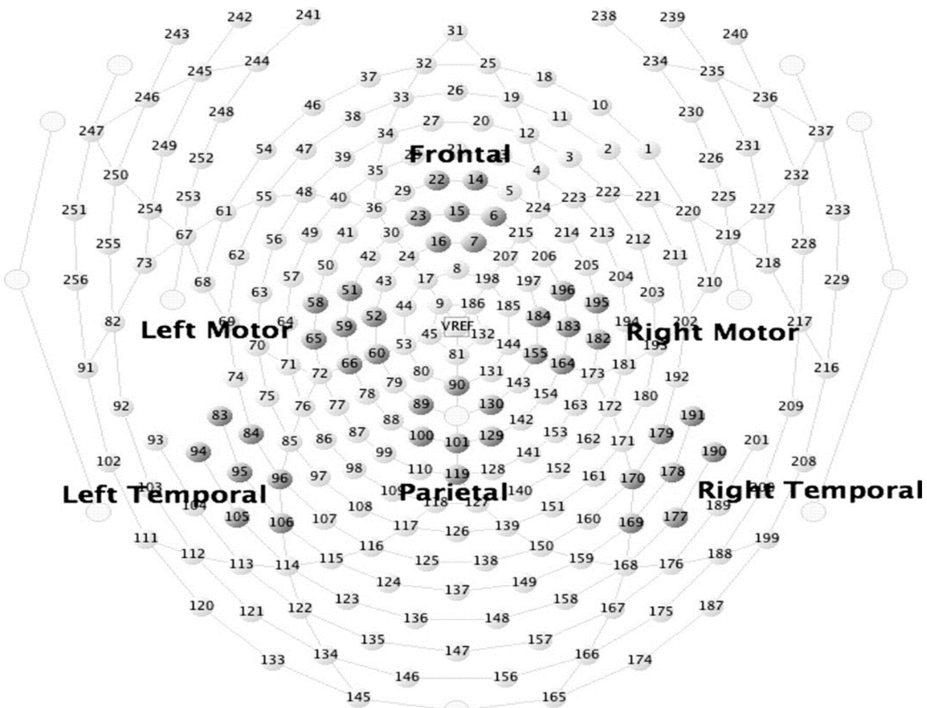


Figure 7. Electrode placement on a 256 channel dense array geodesic net.

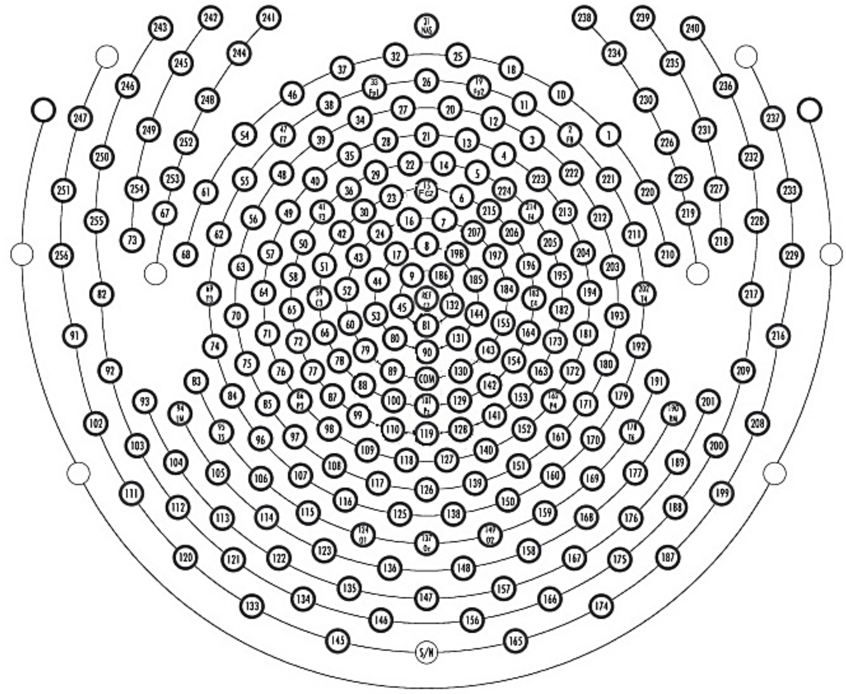


Figure 8. Electrode placement on a 256 channel Hydrocel geodesic net 1.0 for illustration only.

2.2.3 Recording Clean Data

The effect of recording clean data is essential for accurate and valid research (Kappenman & Luck, 2010, 2016; Luck, 2014a, 2014b; Tanner, Morgan-Short, & Luck, 2015; Tanner et al., 2016; Woodman, 2010). Background EEG signals and noise obscures the ERP's, the only means of reducing the noise is through averaging over several trials (or, as a result of filtering (see section 2.2.7) but, this is a form of data distortion). However, this is not a linear relationship; the signal-to-noise ratio (SNR) increases (noise decreases) as a function of the square root of the number of repeat trials (Luck, 2005; 2014b, Dicketer and Kieffaber, 2014; Luck & Gaspelin, 2017). The relationship can be represented as

$$\frac{R}{\sqrt{N}}$$

Where R is the noise in a trial and N is the number of trials (Kamel & Malik, 2015). The SNR can improve as a result of an increase in trial number (i.e. due to low SNR it is difficult to discriminate the required component from resting state EEG) however, repeated image presentation (via duplicating stimuli presentation) could alter the meaning of the image content, potentially habituate or prime the participant and therefore change the response (e.g. see Luck, 2014 for overview; Kamel and Malik, 2015). Therefore, recording high quality, clean data was preferential over a substantial increase in trial number or an increased sample size. This was especially true as when the participant number is between 30 to 40 per group, the chance of error is less than 1% (e.g. Indira, Vasanthakumari, & Sugumaran, 2012; Sands, 2009). Moreover, even though increasing the sample size does reduce the effect size, when using EEG methodologies it does not produce additional knowledge and is not considered time (participation took between 45 minutes and 1 hour to complete), or cost, effective (Indira et al., 2012; Sands, 2009).

2.2.4 Sampling Rate

The Nyguist sampling theorem dictated that digitized reproduction of analog waveform samples should have a sample rate that was at least twice the maximum frequency response to ensure that distortion (aliasing) did not occur (Srinivasan et al., 1998b).

The Nyquist criterion:

$$\mathbf{fd}\boldsymbol{ig} > \mathbf{2}\boldsymbol{fmax}$$

However, the preferential and more cautions extension is that of the engineer's Nyquist which has suggested that the sampling rate should be at least two and a half times that of the maximum response frequency (Luck, 2014a, 2014b; Srinivasan et al., 1998b).

The engineer's Nyguist criterion:

$$\mathbf{fd}\boldsymbol{ig} > \mathbf{2.5}\boldsymbol{fmax}$$

This principle was undertaken within the data acquisition throughout the experimental chapters of this thesis. The sampling rate had a frequency of 250 samples per second. This surpassed requirements (Dickter & Kieffaber, 2014).

2.2.5 Amplifier and Amplifier Gain

The input signal measured at the scalp by the recording electrodes consisted of five sources across a spectrum of frequencies; the target biopotentials, untargeted biopotentials, power line interference signals and the harmonics thereof, interference signals generated by the tissue/electrode interface, and noise (Teplan, 2002). The targeted biopotential signal was small and required amplification prior to computational storage. The system used was tuned to the same gain (amplification factor) for every channel (gain value x1000) and the manufacturer suggested that accuracy was within 5%. This was within accepted norms (Luck, 2014b).

2.2.6 Scalp Locations and Spatial Sampling

In a similar practice to the sampling rate (see ch 2.2.4) that was chosen based on the theoretical posits of the Nyquist theorem (see ch 2.2.4), spatial sampling (both density and coverage) are considered important when recording EEG data (Keil et al., 2014). Inadequate spatial sampling can bias the estimation of average referenced data (Junghofer, Elbert, Tucker, & Braun, 1999) and lead to errors in localisation of ERP source (Lantz, Grave de Peralta, Spinella, Seeck, & Michel, 2003).

Data was recorded from every electrode on the geodesic high density 256 channel nets and therefore provided excellent topography of activation over the cortices (these have been provided throughout the results for visual representations). However, small clusters of electrodes were averaged together (see Table 1.) around the main locations of focus (Pz, Cz, Fcz, Fz, T7 and T8). These locations have been repeatedly used within previous research (Bailey & West, 2013; Engelhardt, Bartholow, Kerr, et al., 2011; Krug et al., 2000; Meaux, Hernandez, et al., 2014; Meaux, Roux, et al., 2014; Mocaiber et al., 2010; Nasr, 2012; Panasiti et al., 2014; Yu, Prasad, Mir, Thakor, & Al-Nashash, 2015; Zheng et al., 2015) and have been identified as key locations within research investigating the effects of for example, media exposure (Bartholow et al., 2006; Engelhardt, Bartholow, Kerr, et al., 2011), sex differences (Gardener et al., 2013; Lithari et al., 2010), emotion (Liu et al., 2012; Sato, Kochiyama, Yoshikawa, & Matsumura, 2001; Q. Zhang & Lee, 2012), attention (Schupp, Cuthbert, et al., 2004; Schupp et al., 2003; Schupp, Junghofer, et al., 2004), criminality (Zukov, Ptacek, & Fischer, 2009) and aggression (Bartholow et al., 2006; Engelhardt, Bartholow, Kerr, et al., 2011).

Table 1. Selected scalp locations with relevant electrode site number and cluster electrode numbers.

<table>
<tr><th colspan="2">Locations</th><th>Electrode</th><th>Clustered Electrodes</th></tr>
<tr><td colspan="2">Fz</td><td>21</td><td>13, 14, 21, 28, 27,</td></tr>
<tr><td colspan="2">Fcz</td><td>15</td><td>14, 23, 6, 7, 16</td></tr>
<tr><td colspan="2">Cz</td><td>Ref</td><td>9, 45, 81, 186, 132</td></tr>
<tr><td colspan="2">Pz</td><td>101</td><td>101, 119, 100, 89, 90, 110, 129</td></tr>
<tr><td>T7</td><td rowspan="2">Ch 3. only.</td><td>95</td><td>95, 96, 84, 94, 83, 105, 106</td></tr>
<tr><td>T8</td><td>178</td><td>178, 179, 190, 191, 169, 177, 170</td></tr>
</table>

2.2.7 Epochs

Traditionally, there has been a tendency to measure ERP components via their peak latency (Luck, 2014b; Luck & Gaspelin, 2017; Woodman, 2010) and refer to the magnitude on the peaks. However, these arbitrary local maxima measures (positive and negative peak amplitude) have been potentially misleading and it has been recently suggested that it may have restricted true understanding of the data and results (e.g. Luck, 2014b; Keil, et al. 2010). This is further discussed in section 2.4. Data analysis.

Measuring the peak of an ERP component can lead to erroneous and misrepresentative data as the wave would still likely be contaminated with fluctuations due to noise even post low – pass filtering (Woodman, 2010). These fluctuations have led to the inflation of Type 1 errors (i.e. an increase in false positives), especially where the data has been used to determine the statistical analysis (e.g. see Keil, et al. 2014). More importantly, literature has suggested that the measurement of the peak of a wave only offers minor information about a process that is approximately halfway through (Woodman, 2010). It could be argued that both the onset and offset of the component are equally as important as the peak measurement (Luck, 2014b).

Although it is common knowledge that EEG methodologies have highly accurate temporal resolution, the precise timing of a specific component is confounded by an inherent voltage overlap between components in both time and space (Woodman, 2010). For example, the late offset of an N2 component could overlap with the onset of P3. This component overlap has proven difficult to address with statistical techniques (Luck, 2014b) and can further confound any assumptions derived from peak measurement analysis. Based on the afore justifications, Woodman (2010) and Luck (2014b) suggested that there should be caution in quantifying ERP components through peak measurement and instead, focus should be directed toward a broad measurement of temporal windows. The timeframe of the windows should be sufficiently large to encapsulate the component in its entirety across all participant waveforms. Practice and refinement has demonstrated that the windows should be overly broad as this reduced the selection bias noted in peak analysis and has now been viewed as a conservative measurement (Woodman, 2010).

Throughout the experimental chapters, timeframes or epochs, have been referred to by their encapsulated timeframe (e.g. 100ms, 200ms, 300ms, ELPP and LLPP (the latter two were summed to equate LPP)). However, it should be acknowledged that the software used to record the EEG raw data was time referenced so that 100ms referred to a timeframe between 50 – 150ms (see table 2 for further clarification of timeframes). This ensured that any peaks occurring within that particular time slot (potentially the P1 and N1) would be viewable within that specific epoch. These epochs have been previously justified (e.g. Lithari et al, 2010) with peak component amplitude occurring within the timeslots specified.

When extracting data within each epoch, the software used an algorithm that searched for the deflections within the timeframe. This reduced the likelihood of introducing Type 1 errors (Keil, et al. 2014) and reduced the manual time required to individually select 5 deflections for every participant, across each location and image. For example, if the experiment recruited 50 participants, across 5 scalp locations, and 150 trials. This would equate to identifying, manually selecting and marking a minimum of 37500 deflections. This figure was based on only one deflection per second. Within the experimental chapters of this thesis there were up to 5 different epochs and several individual identifiable deflections per second of data that were analysed. This would have meant manually marking approximately 188,000 deflections. Therefore, epoch analysis was considered the most appropriate method due to time constraints, reducing bias and the inclusion of the full peak deflection to support recent best practice methodology literature (Kappenman & Luck, 2016; Woodman, 2010). Additionally, as the data was averaged (i.e. grand averaged), any variance across deflection amplitude was smoothed out over the data range during processing and analysis (Dickter & Kieffaber, 2014; Luck, 2014b).

Table 2. Epoch names, the timeframes (ms) they contain and ERP components of interest that have been related to the epochs.

Epoch		Timeframe (ms)	Related Components
Pre-stimulus		-100 to 0	
100ms		50 to 150	N1, P1, early onset of N170.
200ms		150 to 250	N2, P2, N170
300ms		250 to 450	P3a, P3b
ELPP	Together = LPP	450 to 650	The early components of the LPP

2.2.8 EEG Data Process & Procedure

Raw data must go through a process of stages to remove noise and other irrelevant artefacts so that values used for statistical analysis can be extracted. For reader transparency, the process has been provided in a diagrammatic format below (see Figure 9.). Each process point has been outlined and discussed separately in the following subheadings.

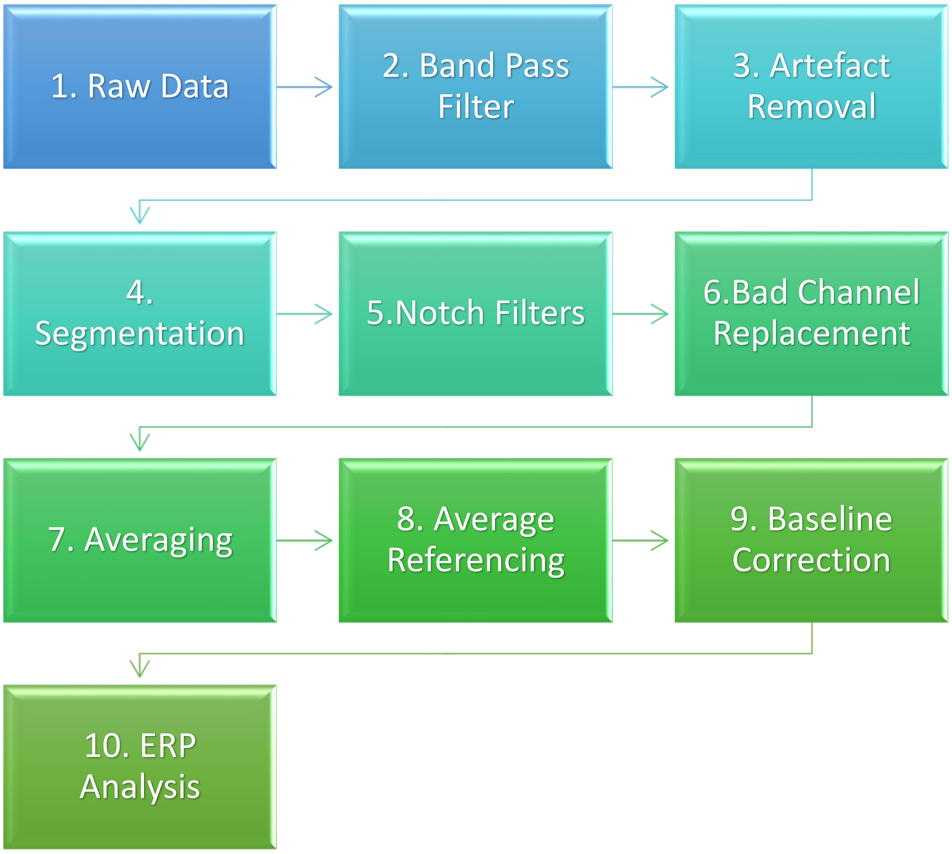


Figure 9. A data process flowchart demonstrating the steps involved in pre-processing of the EEG data from raw data through to statistical analysis. Stages 2 – 9 (inclusive) were completed using custom scripts and functions within EEG Software; Netbase.

2.2.9 Band- Pass Filtering (High and Low Pass)

EEG records data across band waves; delta, theta, alpha, beta and gamma. Each band has a frequency associated with it e.g. Delta waves (0.1 to 3 Hz), theta waves (3 to 8 Hz), alpha waves (8 to 12 Hz), beta waves (12 to 38 Hz) and gamma waves (38 to 42 Hz) (Dickter & Kieffaber, 2014). However, raw EEG data is confounded by noise and artefacts including bioelectric sources; ocular movement and environmental sources. Digital filters have been widely adopted to remove, or attenuate, frequencies that are outside the goals of the research (Kamel & Malik, 2015; Nitschke, Miller, & Cook, 1998) and rely on the assumption that the signal is stationary (Zhang & Lee, 2012) and the EEG data has normal distribution (Gaussian) (Luck, 2014b). However, both the mean and covariance do change across segments and are therefore only considered static within short time epochs / segments i.e. quasi-stationary (Sanei & Chambers, 2007) and the Gaussian assumption only holds true when participants are not required to carry out either mental or physical activities (Sanei & Chambers, 2007). All experimental chapters throughout this thesis required participants to passively observe imagery and therefore digital filtering was recommended.

The EEG software (Net Station) used two digital filter types; the Infinite Impulse Response (IIR) and the Finite Impulse Response (FIR). IIR filters were implemented for use when viewing data/ real time use due to their excellent computational speed however, this filter type lacked a linear phase hence had the potential to distort the data (Electrical Geodesics Inc, 2006). Thus, in addition to the IIR filters, the more computational memory dependent, FIR filters, were used. Both digital filter types were provided as standard within the Netstation software.

Three types of filtering technique were applied to the data; Highpass; Lowpass and Notch. Please see chapter 2.2.10 for discussion on the latter, Notch filtering. The application of highpass filters reduced the low frequencies recorded from bioelectric sources (such as breathing) with a cut off frequency that typically falls within the range of 0.01 Hz to 0.7 Hz (Kappenman & Luck, 2010, 2016; Tanner et al., 2015; Teplan, 2002). Tanner et al. (2015) provided evidence that suggested the use of high pass filters above 0.3Hz induced artifactual components to the data, which could lead to spurious conclusions being drawn from the data, especially in the later wave components (e.g. 400ms onward).

Lowpass filters were applied that reduced the noise from higher frequencies external to the requirements of the research (e.g. mains interference). For this type of EEG research, typical frequency cut off is within the range of 40Hz up to less than half the sampling rate (see Chapter 2.2.4 for sampling rate discussion) (Dickter & Kieffaber, 2014; Luck, 2014b). The dual use of both low-pass and high pass filtering has been referred to as band pass filtering (see Luck, 2014b for overview) and attenuated / removed frequencies above 40Hz and below 0.1Hz. Luck (2014b), Widmann et al. (2015) and Maess et al. (2016) have suggested that filtering using band pass values as above ensured that noise artefacts were reduced in a statistically accurate and valid way (for an overview see Luck, 2014, Ch 8).

2.2.10 Artefact Detection / Removal

Artifacts such as muscular (facial contortion) or ocular movement (e.g. blinking) and other unwanted participant or technical related signals, distort the EEG recording and significantly contaminate the data (Delorme et al., 2011; Islam, Rastegarnia, & Yang, 2016; Walter, 1938). Extensive research has been conducted with the aim of accurately identifying artefacts and how to reduce their effects within the pre-processing stages (Delorme, Sejnowski, & Makeig, 2007; Islam et al., 2016). To date, there has been no universal algorithm or technique (spatial or empirical) that has been accepted and adopted. However, 'bad' channels (e.g. input signals with artefact contamination), have statistical distributions that drift from a Gaussian distribution (e.g. positively skewed) in comparison to noncontaminated data channels and can be identified by using several techniques in conjunction (e.g. methods based on regression, principal components analysis (PCA) and independent component analysis (ICA)) and removed in a rigorous and effective manner (Luck, 2014b; Wallstrom et al., 2004; Woodman, 2010).

For the purpose of this thesis, the selection of pre-programed algorithms that were provided within the Netstation software were run and the data was visually inspected for any errors or additional bad segment / channel identification thereafter. Bad segments of data were automatically detected and rejected for use within the further processing and data analysis. Bad channels were measured as deviations in microvolts over the segment whereas ocular artefacts were measured as a difference in voltage between the pairs of channels (eye blink; channels 8, 238, 37, 241 and eye movement; channels 26, 252) (Miller, Gratton, & Yee, 1988). However, this was not a manual process as the software, Netstation, automatically chose which channels to measure the difference in voltage between (Electrical Geodesics Inc, 2006).

2.2.11 Segmentation

A delay induced between Eprime (stimuli onset) and the recording computer was found to be 18ms that was constant across trials. To compensate for this delay, the time was factored in during segmentation as per manufactures suggestions. Data was then segmented into 100ms pre-stimuli and 900ms post stimuli presentation epochs. This allowed the full waveform to be viewed and extracted for analysis.

2.2.12 Notch Filtering

Notch Filters removed INT AC current that can be present in the external environment or conducted by certain participants (Jung et al, 2000). However, due to the use of a bandpass filter that was set at a high frequency of 40Hz (see section 2.2.7), a notch filter was not required (Maess et al., 2016; Widmann et al., 2015).

2.2.13 Bad Channel Replacement

Bad channel replacement reconstructed and replaced data of low quality or non-existent channels with data interpolated (spherical splines method) from the proximate channels (Fletcher, Kussmaul, & Mangun, 1996; Greischar et al., 2004; F. Perrin, Pernier, Bertrand, & Echallier, 1989). The bad channels were identified during the artefact detection/ removal stage (see Chapter 2.2.10). The channel replacement algorithm only used the data from channels that had recorded high quality data. Errors have been shown to exist in interpolated data when using less than 64 channels however, validity has increased for research using 128 or 256 channels due to an increase in active channels (e.g. Luck, 2014).

2.2.14 Averaging

ERP's were averaged together to produce grand ERPS for each participant. The use of mean grand averaged data has been preferred over peak amplitude data due to inaccuracies that can occur during the analysis when using peak amplitude (Luck, 2014a; Luck & Gaspelin, 2017) (For further discussion see section 2.2.6 Epochs). The grand averaged ERP's were average referenced to account for the convoluted surface of the brain. By using the grand averaging method, it deemphasized individual variances and highlighted any shared ERP patterns. This method has been used extensively within the field (Bartholow et al., 2006; Kappenman & Luck, 2016; Luck, 2014b; Sel et al., 2015).

2.2.15 Average Referencing (Montage Operations)

The grand averaged ERP's were then re-referenced. Re-referencing averaged data in this manner corrected for the polar average reference effect (PARE)(Dien, 1998; Junghofer et al., 1999). This is defined as the measurement of voltage at any one location is a measure of difference in potential between that location and a location assumed to have zero voltage (Luck, 2014b). However, there is no site that has zero voltage and importantly, it cannot be assumed that the voltage at any location will be constant across time. Thus, the objective of re-referencing was to accurately estimate a nonarbitrary value of zero in order to reference each location to (Dien, 1998; Electrical Geodesics Inc, 2006; Junghofer et al., 1999; Yao, 2017). A good statistical choice was to use the surface integral (the average across the scalp) as it is generally accepted that the charges across the surface of the cortices cancel out to zero (Nunez, 2010; Yao, 2017). However, this measure is biased and inadequately sampled due to the fact that the full scalp was not measured using the dense array nets (e.g. underneath the chin). Therefore, only using the surface integral method consistently leads to a PARE. Thus, a more conservative and representative value was derived using the PARE-corrected average reference approach which used spherical spline interpolation to estimate the unmeasured locations (Junghofer et al., 1999). This analysis was provided within the Net Station software as standard (Electrical Geodesics Inc, 2006).

2.2.16 Baseline Correction

The use of baseline correction can lead to spurious effects (Handy, 2005; Luck, 2014a; Tanner et al., 2015; Urbach & Kutas, 2006) and it has been suggested that its application could be successfully replaced with high-pass filtering only (Herrmann, Schlichting, & Obleser, 2014; Maess et al., 2016). However, Tanner et al. (2016) argued that the lack of baseline correction could produce significant differences in initial pre-stimuli amplitude. This could provide false, yet theoretically viable, ERP effects (Tanner et al., 2016). Widmann et al. (2015) suggested that applying a frequency cut off that was relatively low for a high – pass filter (theoretically this would delete DC offset and slow drifting) could correct the pre-stimuli ERP amplitude to zero. However, Tanner et al. (2016) demonstrated several potential issues with this alternative method, especially when investigation was focused on analysis of the time-domain. It was therefore considered best practice to apply a baseline correction to ensure that baseline values were equal prior to stimuli presentation. This ensured that amplitude differences in relation to stimuli category were visible and reduced confounding variability due to any initial ERP pre-stimuli amplitude.

There are several different baseline correction approaches (e.g. Absolute; Relative; Relative Change and Decibel) however, throughout the data processing stages of the following experimental chapters, the absolute baseline approach was adopted. This method subtracted the mean distribution of a one second interval (baseline) from the evoked ERP (see Urbach and Kutas, 2006).

2.2.17 Presented Stimuli

There were two sets of images used throughout the thesis with several categories of differing image content within. These were used as stimuli to record participant EEG in response. There were a set taken from the IAPS (Lang, Bradley, & Cuthbert, 2008) (see Chapter 2.2.17.1) and the second set of images were chosen based on specific criteria (see Chapter 2.2.17.2).

2.2.17.1 International Affective Picturing System Images

Although there has been some convergence on overall concluding comments across the field regarding responses toward emotive stimuli, findings have not been conclusive. This could be attributed to the variance across measures and stimuli used. Research to evoke an emotional response have employed a wealth of differing stimuli for example, films (Fernandez et al., 2012; Gasbarri et al., 2007; Oliver, 2014), emotional words (Bertsch, Bohnke, Kruk, & Naumann, 2009; Imbir, Jarymowicz, Spustek, Kus, & Zygierewicz, 2015), images (Carretié et al., 2001; Codispoti et al., 2016; Foti & Hajcak, 2008; Lithari et al., 2010; Polackova & Lacev, 2017; Prause, Steele, Staley, & Sabatinelli, 2015; Prause, Steele, Staley, Sabatinelli, et al., 2015; Versace et al., 2010; Wiens et al., 2011) specific image content (e.g., emotional faces / figures) (Meaux, Roux, et al., 2014; Mocaiber et al., 2010; Nordström & Wiens, 2012; Norman et al., 2008). Although both films and emotional words could be used to record the response, it would be difficult to separate the responses to specific elements of films as responses would like overlap whilst emotive words would entail attempting to disentangle the response to verbal information and word perception (Lithari et al., 2010). Based on this, still imagery was deemed suitable for the requirements of the research.

A collection of images provided by the IAPS (Lang, Bradley, & Cuthbert, 1997; Lang et al., 2008) were used as they have been previously ethically approved and have been considered the gold standard across several fields of research (Bartholow & Anderson, 2002; Bartholow et al., 2006; Codispoti et al., 2016; Codispoti et al., 2007; Engelhardt, Bartholow, Kerr, et al., 2011; Keil et al., 2002; Lang et al., 1997, 2008).

There are regulations regarding the use of the images provided by the IAPS (Lang et al., 1997, 2008) and providing examples taken directly from the IAPS images would breech those regulations. However, the IAPS images are a collection of coloured, normative emotional images (e.g. erotic, violent, neutral and disgust) that have valance and arousal ratings on dimensions: pleasure, arousal and dominance (Lang et al., 2008). Based on this, the IAPS images were used as part of the stimuli presented to participants within the experimental procedures throughout the thesis. Provided below (Table 3.) are the IAPS image numbers that were used. The images were selected for grouping within the categories: Violent, Erotic, Disgust and Neutral. The selection of IAPS images to be included within the categories for each experiment was a careful procedure as there were many images that were included in the violent category but, they were more suited to the disgust category (e.g. images of decomposing bodies / animals or scenes of surgical procedures with the removal of large tumours as the focus). For further discussion see Chapters 3 and 4.

In order to understand the effect of viewing differing affective images on ERP response, the combinations of image categories were presented in a balanced configuration. This meant that the following category of stimuli presented would be statistically unpredictable i.e. of equal probability to any other category. Thus, this presentation method did not skew the response towards any one image category (i.e. Engelhardt, 2011) and thus this design ensured there were no image sequence or target image (e.g. potential to be evident within the oddball paradigm) to predict. Both probability and target sequence have been repeatedly shown to effect response (V. Ferrari, Bradley, Codispoti, & Lang, 2010; Luck, 2014b; Rosenfeld, Biroschak, Kleschen, & Smith, 2005; Steiner, Brennan, Gonsalvez, & Barry, 2013)

Previously images used from the IAPS catalogue have been selected based on their ratings (e.g. valance and arousal) and not the image content (Alpers, 2008; Alpers, Adolph, & Pauli, 2011; Bartholow et al., 2006; Bianchin & Angrilli, 2012; Kunaharan, Halpin, Sitharthan, Bosshard, & Walla, 2017; Lang et al., 2008; Lithari et al., 2010; Polackova & Lacev, 2017; Zheng et al., 2015). Throughout the following chapters, images have been selected based on their content and not arousal or valance ratings in order to understand the response to category specific (e.g. violent or erotic) stimuli as predicted within the theoretical stances (see Chapter 1.3 for theories of aggression overview).

Although it was suggested that a single stimulus presentation could be sufficient to demonstrate media effects (e.g. Bailey, West & Anderson, 2011), EEG methodologists (i.e. Cassidy, Robertson & O'Connell, 2012; Dickter & Kieffaber, 2014; Luck, 2014) have suggested that this could produce erroneous and misrepresentative results and a minimum of 20 stimuli should be used in any one category. Across the experimental chapters of this thesis, there were 30 of each image type within every image category (e.g. violent, erotic, neutral, disgust). This was due to the limitations of the IAPS images. The number of true, category specific images, were limited within the IAPS catalogue. There has been slight contention regarding the optimum number of trials. Huffmeijer et al. (2014) suggested that there should be 30 trials when investigating early wave components and 60 trails for later components (post 300ms stimuli presentation). However, recently Luck (2017) stated that smaller components may require over 100 trials whereas post 300ms components could be reliably measured with between 10-50 trials. Hence, 30 trials, of content specific categories were considered appropriate for use within the standard picture paradigm used throughout the following experimental chapters and has appeared to be a relatively accepted figure even within contemporary research (e.g. Kunaharen et al., 2017).

Table 3. Presented stimuli category and IAPS (Lang et al., 1997, 2008) image reference number

Category	IAPS Image Reference Number
Neutral	1710, 1440, 1441, 2384, 1463, 5199, 1630, 5500, 5635, 5726, 5740, 5825, 5849, 5875, 5982, 7026, 7052, 7057, 7090, 7235, 7512, 7001, 7004, 7006, 7009, 7010, 7016, 7021, 7530, 7900.
Violent	6213, 6250, 6313, 6520, 6550, 6821, 6834, 8065, 6243, 6312, 6315, 6350, 6530, 6560, 6562, 6571, 6831, 6832, 2811, 9403, 9414, 9424, 9427, 9800, 6220, 9404, 9425, 6510, 6263, 6240
Erotic	4008, 4085, 4141, 4142,4210, 4232, 4235, 4290, 4300, 4310, 4460, 4470, 4490, 4520, 4525, 4530, 4531, 4550, 4559, 4561, 4311, 4647, 4652, 4658, 4659, 4668, 4669, 4670, 4692, 4800
Disgust	9405, 9412, 9420, 9433, 9445, 9570, 9594, 3000, 3001, 3010, 3015, 3016, 3019, 3051, 3061, 3063, 3064, 3068, 3071, 3080, 3100, 3103, 3120, 3131, 3150, 3195, 3213, 3261, 3400, 3069

2.2.17.2 Additional Images

There were an additional 120 neutral images used in the third experiment (Chapter 6). These images were categorised as either Landscape; Clouds; Water; Desserts. These were chosen from royalty free images available on the internet and had modifications carried out on them using image editing software (Photoshop, Cs6) to remove any features that would distract from, or attract gaze towards, a specific point. For example, pylons were removed from landscape images, green weeds were removed from dessert images with typically brown grasses (see Chapter 6. for further discussion and examples). All images were of the same size and resolution as the IAPS images so that the screen positioning was consistent across experiments.

In order to understand how emotive the images were and whether they were viewed as content 'neutral', an opportunity sample of 51 participants (age range 18-38) from both sexes (26 females) were asked to rate the images on both valance (a 5 point scale ranging from 'strongly negative' to 'strongly positive') and arousal (scale from 1-10; a 9 point scale ranging from 'calm' to 'excited') and to answer the question 'Were you attracted to anything specific in this image?'. Rating scales have been conducted in similar ways across the research field (Alpers, 2008; Alpers et al., 2011; Bartholow et al., 2006; Kunaharan et al., 2017; Lang et al., 2008). There were 3 participants whose data was removed due to failing to complete the tasks. Participation was voluntary and without incentive. Written consent was obtained for each participant. Results indicated that both males and females rated the images similarly on the arousal and valance scales (see Table's 4 and 5). Females tended to rate all categories, except from clouds, as slightly more arousing than males and they were consistent across sex on valance scores. ANOVA indicated that there were no significant differences between sexes on any of the image categories for valence (clouds ($F(1,47)=0.34$ $p=0.56$); water ($F(1,47)=0.78$ $p=0.38$); landscapes ($F(1,47)=0.57$ $p=0.46$); deserts ($F(1,47)=0.55$ $p=0.465$)) or arousal (clouds ($F(1,47)=0.90$ $p=0.35$); water ($F(1,47)=3.79$ $p=0.06$); landscapes ($F(1,47)=2.79$ $p=0.10$); deserts ($F(1,47)=1.38$ $p=0.25$)).

Overall, this suggested that the images were related to emotionally referenced words such as 'calm' (number 1) on the arousal scale and were found to be most likely depicted as 'neutral' on valance ratings (number 3). The only response to the post rating question 'were you attracted to anything specific in this image'? was 'no' and 'sand' in a desert image. Therefore, there was no further analysis carried out on this data.

Table 4. Means and standard deviations of additional images as rated on a 9-point arousal scale.

Arousal	Male		Female	
Image category	Mean	SD	Mean	SD
Clouds	1.37	0.26	1.33	0.2
Water	1.36	0.28	1.44	0.32
Landscapes	1.40	0.35	1.47	0.30
Deserts	1.35	0.24	1.41	0.28

Table 5. Means and standard deviations of additional images as rated on a 5-point valance scale.

Valance	Male		Female	
Image category	Mean	SD	Mean	SD
Clouds	3.08	0.12	3.12	0.16
Water	3.10	0.95	3.05	0.71
Landscapes	3.05	0.06	3.08	0.09
Deserts	3.03	0.06	3.01	0.05

2.3 Additional Measures & Measurement Tools

There were two psychometric tools used to measure demographic information and trait aggression.

2.3.1.1 Measuring Demographic Information and Lifestyle Choices

Information such as sex, age, preference towards violent films or violent videogames, self-rated view of ability (scale of 0 – 10); length of time playing videogames (in hours), and whether they had been a witness or a victim to a violent crime were recorded through the use of a demographic questionnaire (see Appendices E). This questionnaire provided dichotomous variables to be extracted and used within the analysis.

Obtaining participant VVG history and preference details via this method was the preferred technique of categorising participants as it did not require any laboratory learning or priming to take place. For instance, laboratory based VVG exposure has the potential for high experimental control although it lacks external validity. In general, VVG players are exposed to VVG over time where their expertise has the potential to develop and their preference can be refined (e.g. Bowen and Spaniol, 2011). The theoretical predictions of the GAM suggest that those with preference towards watching violent films and VVG play should demonstrate differences in processing of VM in comparison to those participants who prefer to watch non-violent films and/ or, do not play VVG or have preference towards non-violent VG play. Hence, could potentially offer valuable insight into the effect of media. All variables used had been previously indicated as possible influences on response towards affective imagery or on trait aggression score and were therefore included for further investigation.

Allocation to dichotomous group variables was based on a simple coding process. Responses to the demographic questionnaire questions related to each variable dictated the group allocation. For example, if participants answered that they had been a previous witness or victim to a violent crime, they were allocated to that group. Allocation to whether they preferred to watch violent films or play VVG's was based on the age rating and warnings for the films/ games they preferred to play. If the game or film they had stated for their response was found to contain violent content, they were allocated to that group.

2.3.1.2 Measuring Trait Aggression

The Buss and Perry (1992) Aggression Questionnaire (BPAQ) was completed by all participants who volunteered to take part in any of the experimental procedures. The BPAQ (Buss and Perry, 1992) is a 29-item questionnaire that was used to record self-reported aggressive traits (i.e. anger and hostility) and forms of aggression (i.e. verbal and physical) (see Appendices F). Scores on the four subcategories (Physical Aggression, Verbal Aggression, Anger and Hostility) were combined to produce total aggression. Test/retest reliability, construct and internal validity for the subcategory scales have been found to be high (Buss and Perry, 1992). This measure has been widely used both internally and externally to the social sciences and although there have been refinements (Haden, Scarpa, & Stanford, 2008; Hutchings, Gannon, & Gilchrist, 2010) and attempts in advancements, it is still considered the gold standard (see chapter 1.4) (Gerevich et al., 2007).

2.4 Data and Analysis

As has been previously discussed throughout this chapter a process was followed in order to collect, collate and deduce a high standard of data that could be used for analysis. Initially, raw EEG/ERP data was band-pass filtered, thus heavily attenuated frequencies were removed (Low-pass filter set to 40Hz and high-pass filter set to 0.1 Hz). Data was then segmented into 100ms pre-stimuli and 900ms post stimuli presentation epochs. Computational algorithms removed biological artefacts (e.g. ocular or muscular) and AC current that can be present in the external environment or conducted by certain participants (Jung et al, 2000). Bad channel replacement removed channels that were unresponsive or external to current research parameters and made approximations based on other channels in the local proximity (spherical splines algorithm method). ERP's were averaged together to produce grand ERPS for each participant. These were then average referenced to account for the convoluted surface of the brain. The final stage was baseline correction where a baseline value between stimuli was provided.

Demographic information and trait aggression scores were extracted from two questionnaires; the Demographic questionnaire BSPAQ (Buss and Perry, 1992). Trait aggression scores on the four subcategories (physical aggression, anger, hostility and verbal aggression) were summed to produce a total aggression score for each participant.

The EEG data was extracted, transposed and analysed using the EGI Net Station 4.5 program, Microsoft Excel and SPSS v22 respectively. Grand mean averages were extrapolated and statistical analysis were conducted to examine any differences between variables (Field, 2013; Howell, 2013). Post-hoc comparison analysis' (e.g. Bonferroni) were conducted to examine which groups differed in comparison to the means of other conditions where required and justified (Howell, 2013).

Luck and Gaspelin (2017) suggested that there was a potential with EEG data analysis to produce bogus effects. There were several steps that were undertaken throughout the experiments and analysis to reduce any the chance of bogus effects occurring. All research undertaken was based on a priori hypothesis testing rather than HARK-ing (hypothesising after the results are known) (Forstmeier, Wagenmakers, & Parker, 2017). This was also the case for all epochs, scalp locations and images used. The foundations were based and justified with grounded theoretical suggestions, previous research or practical and contemporary methodology.

In addition, both familywise and experimentwise error rate can be at a 100% chance of false positive results based on repeated tests. Luck and

Gaspelin (2017) suggested that this had been overlooked in the past and could potentially be a detrimental mistake. However, it should be acknowledged that the following analyses had no multiple comparisons made on them (other than chapter 5 where each analysis was separately discussed). Every analysis or 'comparison' made could have been a separate research question. However, there was enough evidence to choose all locations (these were reduced to just the midline from chapter 4 onwards thus, aiding with reducing potential error rate), epochs, image categories, and data extraction methods.

Luck and Gaspelin (2017) stated that when attempting to reduce the probability of bogus effects whilst holding the SNR high, researchers sometimes suggest an increase in number of stimuli. However, due to the relatively small number of suitable category specific options available from the IAPS catalogue, a selection of additional images was not a possibility. A further option was to display the images in a repeated format thus, increasing the number of trails as numerous research has done previously (Bartholow et al., 2006; Liu et al., 2015). However, that has been shown to produce habituation / fatigue effects on EEG (Anokhin et al., 2006) thus, would not be in line with the research aims. Alternatively, increasing participant number can provide a similar reduction in potential bogus effects (Forstmeier et al., 2017; Luck & Gaspelin, 2017). All experiments undertaken, inclusive of the initial exploratory study, had a number of participants that was considered large for EEG experiments (Dickter & Kieffaber, 2014; Indira et al., 2012; Luck, 2014b; Pfabigan, Lamplmayr-Kragl, Pintzinger, Sailer, & Tran, 2014; van Lankveld & Smulders, 2008).

2.4.1 Types of analysis

Grand mean average ERP's were extrapolated and ANOVA's were conducted to examine any differences between variables (Howell, 2010). Where required, the conservative Bonferroni post-hoc analysis' were conducted to examine which groups differed in comparison to the means of other conditions (Howell, 2013). There were several types of analysis conducted throughout the thesis (e.g. Independent Samples T-test; One-Way ANOVA; Repeated Measures ANOVA; Mixed ANOVA) however, each test was a test of difference between groups and met the assumptions of the test selected.

There were three specific types of ANOVA conducted across the results sections of the thesis. The One-Way ANOVA; Mixed ANOVA and Repeated Measures ANOVA. All three methods are similar in the way the statistics are conducted as both sum the *F* statistic as a means of showing the likelihood of finding the results provided within the population however, they differ on where the variance is apportioned (Field, 2004; 2013).

There are 6 main assumptions that should be met in order to conduct an ANOVA (Field, 2010). The independent variable should be measured at interval or ratio level (i.e. continuous data); the independent variable should have more than one categorical and independent group; there should be no relationship between observations within and between groups (Independence of observations); there should be a lack of significant outliers; the dependant variable should approximately hold normal distribution for each category of independent variable; lastly, there needs to be homogeneity of variance otherwise the alternative Welch ANOVA should be conducted (Field, 2013; LaerdStatistics, 2017) with large enough groups statistical power is upheld (Delacre, Lakens, Mora, & Leys, 2018). Although in the case of the relatively robust ANOVA, Field (2013) stated that minor violations of assumptions could be ignored within reason, as these can still provide valid results.

It was imperative to consider both how groups differ on response toward one image at one epoch and at one specific location (e.g. one-way) in comparison to the differences between groups across the image categories at one specific epoch, and location (e.g. repeated measures or mixed). Importantly, it was not appropriate to compare across location (i.e. electrode) or time point (i.e. erp component) (Luck, 2014b). However, all three types of ANOVA required additional post hoc testing to demonstrate if/where the differences were statistically significant. Throughout the analyses of data within the thesis, all three methods have been employed.

In order to understand the effect of Aggression in chapters 3 and 5, it was investigated whether an Analysis of Covariance (ANCOVA) and the extension; Multiple Analysis of Covariance (MANCOVA) could be used as they can show the differences between variables in 2 or more groups whilst accounting (sometimes termed correcting for) the variability of other variables (e.g. covariates). However, after extensive consideration it was apparent that the use of either analysis could be a misinterpretation of their correct use (Miller & Chapman, 2001). Field (2013) stated, "when treatment groups differ on the covariate, putting the covariate into the analysis will not 'control for' or 'balance' the differences" (p.484). This misinterpretation usually occurs when participants are not randomly assigned to the experimental conditions (which cannot be the case within the analysis' throughout the thesis as sex was viewed as an independent variable and is biologically predefined. Thus, cannot be randomised) (Field, 2013; Howell, 2013). This was similarly the case for Aggression scores, as individuals were not randomly assigned to their group rather, their score defined their condition/ category. Field (2013) further suggested that both age and traits have also been a misapplication of this as the covariates include some variance of the effect of the alternative variable (e.g. Sex and Aggression). Even though there have been published journal articles where these methods of analysis have been employed, it was felt inappropriate to use the method simply due to others having used it.

As previously stated, one of the aims of the thesis was to ensure that all methodology and analysis undertaken was viewed as appropriate, justifiable and as grounded as possible. It was therefore considered that using these types of analysis would be an inappropriate use thereof.

Chapter 3 **We Are What We See?**

3.1 Abstract

The investigation of the behavioural and neurological effects of both short and long-term exposure to violent media have provided inconclusive results. There has been a plethora of research proposing that there are both detrimental (e.g. Anderson and Bushman, 2001; Malamuth and Briere, 1986) and beneficial (e.g. Gentile et al., 2009; Gitter, Ewell, Guadagn, Stillman and Baumeiste, 2013) effects of digital media on the brain and behaviour. It has been theorized that violent and erotic media exposure modifies neurological processing of visual stimuli and increases aggressive and sexually aggressive thoughts and behaviours (e.g. Anderson and Bushman, 2001; Malamuth and Briere, 1986). The present study addressed previous methodological concerns and assessed the fundamental basis of media research (e.g. Ferguson & Kilburn, 2010) by investigating whether alternative factors such as previous life experiences, lifestyle choices and demographic information had an effect on neurological responses towards affective images. This aimed to assess the foundations of neurological media research and to subsequently advance understanding of the neural basis of aggression and the media effect (e.g. desensitisation). Event related potentials (ERP's) were recorded across 1000ms post stimuli presentation to encapsulate common ERP components (e.g. N100, N200, P300 and LPP) from participants (n= 32) who had also completed questionnaires (Buss and Perry (1992) Aggression Questionnaire and a demographic questionnaire). Results showed that factors such as sex, previous experience of violent crime and individual preferences towards violent media had a significant effect on ERP amplitude in response to affective images. These findings showed some support for the Catalyst Model of Aggression (Ferguson, 2007), a female negative bias (Lithari et al, 2010) towards affective imagery and research and theory that has suggested that attention is motivated towards evolutionary salient stimuli (e.g. Gur et al, 2002; Kim et al. 2013; Schupp, Junghofer, Weike and Hamm, 2003; Weinberg and Hajak, 2010; Wheaton et al, 2013), and preferred media content (Boheart, 2001; Nordstrom and Wiens, 2012). Methodological limitations have been outlined with evidence and justification for further research provided.

3.2 Introduction

There has been research (e.g. Bathelow, Bushman & Sestir, 2006; Engelhardt, Bartholow, Kerr, & Bushman, 2011; Huesmann, 2010; Malamuth, Addison, & Koss, 2000; Malamuth, Hald, & Koss, 2012) and theories (e.g. Anderson & Bushman, 2001; Malamuth, 1986) proposed that has implicated both violent media (VM), and erotic media (EM) as causal of both short and long-term detrimental effects on the brain and subsequent behaviour. The GAM (Anderson & Bushman, 2002); IEM (Malamuth, 1986), CMoA (Ferguson, Rueda, et al., 2008) and CM (Malamuth et al., 2012; Malamuth et al., 1996) have shown how influential both VM and EM may be and there has been a great deal of experimental research investigating the effects (see Ch 1.). However, there has been a selection of academics that have voiced concerns regarding several unaddressed issues (e.g. Elson, 2016; Ferguson, Rueda, et al., 2008). For example, the reliance of unjustified theoretical assumptions, the use of non-standardised methodology, unvalidated use of measures and stimuli and a lack of statistical rigour that has led to an evidence base that is largely built on correlational findings and minimal effect sizes (e.g. Chadee, Smith, & Ferguson, 2017; Ferguson, Rueda, et al., 2008; Ferguson, San Miguel, Garza, & Jerabeck, 2012; Grimes, Anderson, & Bergen, 2008 Ferguson, 2007). For instance, the Taylor competitive reaction time test (TCRTT), where the participant is informed they are to compete against an opponent (confederate) with the objective of pushing a button the fastest after a visual cue. The winner is permitted to deliver a punishment, post-trial, to the loser and can select the intensity and duration of the punishment (e.g. noise blast) (Adachi & Willoughby, 2011; Taylor, 1961). The measure of intensity and duration of the chosen punishment has been used as a measure of aggression (e.g. Anderson and Dill 2000; Anderson and Murphy 2003; Bartholow et al. 2006; Carnagey and Anderson 2005) (see Ch 1.2 for a more detailed description). It has been shown that the tool has been adopted and adapted without consistency (e.g. authors have used several versions of the method) therefore, there can be no comparisons made between research and very little drawn from the results (Adachi & Willoughby, 2011; Ferguson & Rueda, 2009).

In order to understand the effects of ‘negative’ media on the brain and behaviour it was imperative that any experimentation minimalized the highlighted confounding variability where possible (i.e. using validated and standardised measures of aggression; using validated and research relevant stimuli; using a balanced stimulus presentation). However, subsequent media research (Coyne, 2016; Coyne et al., 2011; Coyne, Stockdale, & Nelson, 2012; DasGupta, 2017; DeWall et al., 2011; Engelhardt, Bartholow, Kerr, et al., 2011; Greitemeyer, 2014; Groves & Anderson, 2015a, 2015b; Groves et al., 2016) has continued to build upon the heavily criticised foundational findings and therefore, could have missed the true effects.

Most early work in the media research field focused on the effect on VVGs and aggression (e.g. Anderson & Bushman, 2001; Sherry, 2001). In line with the GAM (Anderson and Bushman, 2002) that stated that based on the influence of personological variables (e.g. trait aggression) and situational variables (e.g. media exposure), VVG exposure resulted in the development of aggressive thoughts and emotions, increased physiological arousal and led to increased aggression (e.g. Bartholow et al., 2006; Carnagey et al, 2007; Engelhart et al., 2011). Researchers also influenced by the GAM, began examining the positive effects of prosocial videogames and aggression. It was shown that in comparison to playing a neutral videogame, a prosocial VG increased helping (Gentile et al., 2009), primed more prosocial thoughts (Greitemeyer & McLatchie, 2011), reduced state hostility (Saleem, Anderson, & Gentile, 2012) and reduced aggression (Greitemeyer, Agthe, Turner, & Gschwendtner, 2012; Greitemeyer & Mugge, 2014). However, the explanation for this effect is still uncertain and there has been a lack of neurological research and investigation exploring these points (Greitemeyer & Mugge, 2014).

Engelhardt, Bartholow, Kerr, et al. (2011) suggested that aggression could be predicted via the measurement of ERP's. Specifically, the P300 component. It is generally accepted that an increased ERP amplitude would be elicited for media content viewed as emotive (i.e. depictions of violence, erotica, mutilation, disgust) (e.g. Schupp et al., 2000; 2004). However, Engelhardt et al., (2011) suggested that a reduced P300 amplitude was evidence of a desensitisation effect (the smaller the P300 amplitude, the more desensitisation) in participants selected based on their previous VVG exposure (violent and non-violent). Although the P300 component has been the most widely investigated component of EEG, there has been a vast array of research that has shown the moderating influence of aggression (and associated emotions) on different component amplitudes. For example, Stewart et al. (2010) showed how the N200, P300 and N400 components were influenced by aggression styles when investigating attentional bias using the Stroop task. Those participants found to be of the anger-out personality style showed increased N200, P300 and N400 towards negative words and it was concluded that aggressive individuals employed additional effort to override attention towards negative words. Participants high in the anger-in style were found to have reduced N400 amplitude towards negative words thus, the authors suggested this could indicate that negative information could be pre-primed and required less resource for these individuals.

Early components of the ERP waveform have also been shown to be effective epochs for investigation. Grigoryan, Stepanyan, Stepanyan, and Agababyan (2007) found participants with high levels of aggression showed increased N200 amplitude in frontal regions (e.g. Fz) and a decreased activation over temporal sites (e.g. T7/T8) in comparison to non-aggressive individuals. Although media research has tended to treat participants as a homogenous group (e.g. Bartholow et al., 2006; Bartholow, Sestir, & Davis, 2005) or use same sex participants (e.g. Engelhardt et al., 2011), there has been a valuable contribution from research investigating emotional processing that has shown established sex differences (Filkowski et al., 2017; McGlade et al., 2015). For example, Han, Fan and Mao (2008) found that there were sex differences in both early and late ERP components relative to emotional processing and regulation in a cognitive task.

Similarly, Lithari et al. (2011) investigated early ERP components (N100, and N200) in response to pleasant, unpleasant and neutral images and found significant sex differences in ERP amplitude across the midline measurement sizes (i.e. frontal (Fz), central (Cz) and parietal (Pz) lobes). These results were consistent with the female negativity bias. Females tended to respond more negatively towards affective imagery (i.e. VM and EM) across early time epochs in comparison to their male counterparts. In addition, sex differences have been found across trait aggression, crime rates, violent and erotic media consumption, biological explanations of aggression and ERP amplitudes towards differing affective stimuli (see ch.1.). Thus, sex was viewed as an important factor in this research due to its potential moderating effect and explanatory power (Filkowski et al., 2017; McGlade et al., 2015).

However, as the LPP has been viewed as a reliable index of motivated attentional processing (e.g. for reviews see Ferrari et al., 2008; Olofsson et al., 2008) and was said to be 'the most reliable ERP component modulated by stimulus significance in a passive picture viewing context' (Bradley, 2009, p. 7), modulation of this component could be considered an important indicator of cognitive processing of emotive content. Affective imagery has been shown to evoke increased LPPs in comparison to neutral (e.g. Schupp et al., 2000; 2004). It has been suggested that this was due to motivational relevance (Bradley, 2009; Lang et al., 1997; Weinberg & Hajcak, 2010; Wheaton et al., 2013), subjective preference toward content (Nordström & Wiens, 2012) and evolutionary salience (e.g. Gur et al, 2002; Kim et al. 2013; Schupp, Junghofer, Weike and Hamm, 2003). In addition, activation over the LPP has been linked with early memory encoding processes (Olofsson et al., 2008; Schupp et al., 2003) and thus relevant for mapping any effect of the media. However, no known empirical electrobiological research has examined the effect of alternative factors (e.g. sex or media content preference), aggression and passive picture viewing in relation to media categories theorised to impact cognition and behaviour (i.e. violent and erotic).

Ferguson, Rueda, et al. (2008) stated that real life events such as a history of family violence and experience of violent crime were stronger predictors of aggressive behaviour than VM exposure as, at best, VM served to mould the style of behaviour, not induce the aggressive behaviour itself (i.e. a stylistic catalyst). Thus, this suggested that aggressive behaviour was related to previous real-life events and learning in comparison to exposure to fantasy media. In support, Tan (2009) found no increase in aggression in relation to VM exposure and furthermore, that factors such as aggressive personality traits, were found to more adequately predict aggressive behaviour, a finding that was conducive with the CMoA (Tan, 2009). Due to the design, the current exploratory research could consider both short term and long-term effects of the media as suggested by the GAM. Short term effects explored via the processing towards a rapid presentation of differing media (e.g. Engelhardt et al., 2011) and long-term effects highlighted by understanding the processing of differing types of media relative to preference and experience of that type of content (e.g. VM and EM).

Nevertheless, it should be acknowledged that there was no opportunity to replicate or advance any particular previous research (e.g. Engelhardt et al., 2011) using EEG methodology due to non-disclosure, and potentially unbalanced presentation, of stimuli and paucity of further research (see Ch1.5 for full discussion). Therefore, this pilot scale study was based on justified methodology (see Ch.2.) and conducted in a transparent manor in an attempt to provide non-biased results to act as a baseline and platform for the development of research. Due to the above justifications, an exploratory research question was formulated: Do alternative factors, such as previous life experiences and demographic information, have a significant effect on neurological responses to affective images?

3.3 Key Aims

To conduct a pilot study investigating potential differences in emotional processing due to exposure to violent media employing a methodology that included essential procedures that have been outlined in the literature by EEG methodologists.

Investigate differences between published research data that has had the methodology negatively critiqued and the results from this pilot study, to provide a baseline for further studies.

Investigate potential differences in emotional processing due to alternative factors (e.g. sex, previous life experiences and lifestyle choices) when viewing affective imagery.

3.4 Methodology

3.4.1 Participants

An opportunity-based sample of 32 healthy right-handed volunteers (Male N= 14; female N= 18) participants were recruited to take part in this research. There was a broad age range (females mean= 23.22, SD= 1.65, range 18-44; males mean= 24.93, SD= 1.61, range 20-40). The sample were not paid for their participation, however, first and second year psychology students were awarded research credits for participating. All of the participants had normal or corrected to normal vision, 20/20 (UK). Participants with a history of mental health illness and those currently taking un/prescribed medication were excluded from the study.

3.4.2 Apparatus and Materials

The apparatus used was as outlined in the methodology chapter (see ch 2.).

3.4.3 Design

This research was quasi-experimental in design. All variables (except from image) were based on group differences (not random allocation). The research used both repeated and independent measures. The repeated measures elements were three subcategories of affective imagery taken from the International Affective Picturing System (Lang et al., 1997, 2008). The categories were Neutral, Violent and Erotic (Bartholow et al., 2006; Engelhardt, Bartholow, Kerr, et al., 2011). The independent group's factor measured demographic information such as sex, past experiences (e.g. whether they had been a previous witness or victim to a violent crime) and personal lifestyle preferences (e.g. whether they preferred violent or nonviolent media (films and videogames)). Trait aggression was measured using the BPAQ (Buss & Perry, 1992).

Although, the variables were not directly manipulated, they have been referred to as independent variables throughout. The independent variables (IV) were all alternative factors that have been taken from the literature (e.g. Ferguson et al., 2008; Lithari et al., 2011) and have been discussed in chapter 1. These were sex (2 levels, males and females), previous life experience (Film preference (2 levels, violent and nonviolent), previous experience of violent crime (2 levels, yes and no), videogame preference (2 levels, violent and nonviolent), trait aggression scores (2 levels, High / Low), and image category (3 levels, neutral, violent and erotic). The dependant variable was the grand mean average ERP (measured in microvolt's, µV) scores.

3.4.4 Procedure

The experimental procedure was as outlined in the methodology chapter (see Ch 2.2). Self-report aggression was divided into dichotomous levels within the IV Total Trait Aggression Score; high aggression (scores of 81 on the BPAQ) and low aggression (scores under 81 on the BPAQ).

3.4.5 Data Analysis

The data was processed and analysed as outlined in Chapter 2.

3.5 Results

EEG amplitudes were recorded, standard descriptive statistics have been summarised below across the sequence of tables. Results have been subdivided into sections (1 – 6) for clarity purposes. The subheadings are Section 1: Sex Differences; Section 2: Trait Aggression; Section 3: Witness or Victim to a Violent Crime; Section 4: Preference Towards Playing Violent or Non-Violent Videogames; Section 5: Preference Towards Watching Violent or Non-Violent Film Media and Sections 6:

Topoplots-Visual display of cortical activity over epochs. Within each of the above subsections, analysis of image type has been embedded.

When the sample size was less than 30 and Central limit theorem does not apply, distribution was checked using the Shapiro Wilks test. Where they were found to be non-normal, they were examined for outliers. Where SPSS boxplots identified extreme values, these were removed. Consequent distributions were more normal. ANOVA is quite a robust test to mild violations of these assumptions (Field, 2010). Therefore, on this basis, analysis commenced. Throughout repeated measures analyses of two or more conditions, if any variables were found to violate the assumption of sphericity using Mauchly's Test of Sphericity, the results were corrected using the Greenhouse-Geisser epsilon correction (Field, 2010). Where applicable, the values presented in the below sets of analyses are the corrected statistics (Field, 2010).

For ANOVA results, one assumption that must be met is that comparison groups (independent groups) should have similar dispersion of scores (homogeneity of variance) at all levels of the between-subject variables (Field, 2010). The Levene's Statistic was used as a measure of this. However, generally this would only be a problem with small samples of different sizes and severe violations (Field, 2010). As ANOVA has been viewed as a robust test (Field, 2010), only severe violations with small samples of different sizes were further investigated. Alpha was set at 0.05 throughout. Appropriate post hoc tests were run. For where there were two independent groups, independent t-tests were used and where there were dependent groups, paired samples t-tests were run. For any of these dichotomous variable's alpha was adjusted to 0.025 to take account for inflated type 1 error. For three or more groups, Bonferroni test was used. Cohen's D was used to as an appropriate measure of effect size for any comparisons between two means. As SPSS does not calculate this, Cohen's *d* effect sizes were manually calculated. This type of effect size is based on the mean differences between samples dived by the standard deviation (Field, 2010). Where the standard deviation of groups was unequal, a pooled standard deviation was calculated and used as the denominator.

The data was segmented into epochs (100ms, 200ms, 300ms and 400-800ms) (see Ch 2.). Five main cortical measurement sites were selected to reduce the potential number of statistical tests (see Ch 2); the frontal region (Fz), frontal central (Fcz), parietal (Pz) and temporal lobes (T7 – left hemisphere and T8 – right hemisphere) as demonstrated in Figure 10.

3.5.1 Section 1: Sex Differences

This is the analysis of sex differences by location and epoch in response to affective images. Means and standard deviations have been provided in the below sequence of tables (see Table 6 – 9.). Section 1. data was analysed using mixed ANOVA (Sex, 2 levels: Male and Female x Image, 3 levels: Neutral, Violent and Erotic). Only significant results have been provided below.

3.5.1.1 50 – 150ms Post Stimuli (100ms)

Table 6. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females across Fz, Fcz, Pz, T7 and T8 measurement sites for each image category for the 100ms epoch.

100ms	Male		Female	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-1.39	1.88	-2.78	2.95
Erotic	-1.93	1.48	-2.33	3.01
Violent	-1.46	1.53	-3.50	2.70
Fcz				
Neutral	-1.21	1.36	-2.77	2.73
Erotic	-1.58	1.25	-2.25	2.88
Violent	-1.20	1.17	-3.27	2.39
Pz				
Neutral	0.52	1.59	1.03	4.10
Erotic	0.29	1.27	-0.94	4.56
Violent	0.10	1.47	1.68	2.77
T7				
Neutral	0.77	1.47	-1.10	2.70
Erotic	-0.53	2.33	0.05	2.67
Violent	0.40	1.09	-1.22	2.18
T8				

Neutral	0.10	1.47	-1.17	3.28
Erotic	0.21	1.93	0.14	2.46
Violent	0.32	1.44	-1.12	1.76

3.5.1.2 150 – 250ms Post Stimuli (200ms)

Table 7. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females across Fz, Fcz, Pz, T7 and T8 measurement sites for each image category for the 200ms epoch.

200ms	Male		Female	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-3.48	2.18	-6.08	3.62
Erotic	-2.75	2.51	-3.42	2.85
Violent	-2.57	2.47	-4.70	2.71
Fcz				
Neutral	-3.05	1.86	-5.74	3.44
Erotic	-2.41	2.13	-3.15	2.68
Violent	-2.22	2.05	-4.37	2.68
Pz				
Neutral	3.55	3.02	4.63	8.46
Erotic	1.65	2.20	0.64	8.06
Violent	2.68	3.92	6.17	5.50
T7				
Neutral	1.29	2.94	-2.58	3.91
Erotic	-1.55	4.21	-0.96	3.05
Violent	-0.13	3.09	-2.24	2.77
T8				
Neutral	1.17	3.39	-1.97	4.50
Erotic	-1.17	4.39	-1.20	3.55
Violent	-0.28	3.79	-1.24	2.36

3.5.1.3 250 – 450ms Post Stimuli (300ms)

Table 8. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females across Fz, Fcz, Pz, T7 and T8 measurement sites for each image category for the 300ms epoch.

300ms	Male		Female	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	1.04	3.29	1.36	6.43
Erotic	1.81	5.26	1.62	7.54
Violent	3.40	4.10	1.86	4.79
Fcz				
Neutral	0.48	2.75	0.65	5.95
Erotic	0.96	3.92	0.83	6.88
Violent	1.90	3.27	0.77	4.43
Pz				
Neutral	6.90	2.48	10.06	13.04
Erotic	6.72	4.15	7.87	12.10
Violent	6.60	4.23	14.20	11.05
T7				
Neutral	5.71	3.62	2.92	4.96
Erotic	2.59	4.12	2.82	5.04
Violent	1.39	4.18	0.48	4.54
T8				
Neutral	5.75	3.50	2.64	5.62
Erotic	3.78	3.89	3.20	6.33
Violent	4.27	4.76	3.63	3.85

3.5.1.4 400 – 800ms Post Stimuli (LPP)

Table 9. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females across Fz, Fcz, Pz, T7 and T8 measurement sites for each image category for the LPP.

LPP	Male	Female

Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	3.16	3.11	2.38	6.98
Erotic	2.02	4.40	4.52	8.49
Violent	4.12	3.97	3.92	5.05
Fcz				
Neutral	2.28	2.14	1.62	6.37
Erotic	1.34	3.22	3.17	8.21
Violent	2.68	2.96	2.58	4.83
Pz				
Neutral	5.74	2.18	9.52	15.21
Erotic	6.66	4.60	6.32	12.99
Violent	5.44	5.02	13.92	13.72
T7				
Neutral	5.80	3.11	2.58	5.13
Erotic	4.50	5.33	3.24	5.00
Violent	1.95	3.74	0.22	4.45
T8				
Neutral	5.72	3.73	2.23	6.10
Erotic	4.53	4.46	4.26	7.30
Violent	4.02	4.54	4.28	3.37

There was a significant main effect of sex on ERP activation over the 100ms epoch for the frontal recording sites Fz ($F(1, 30) = 4.11$, $p = .05$, $\eta p2=.12$) and Fcz ($F(1, 30) =6.22$, $p = .02$, $\eta p2= .17$). Post Hoc independent t-test showed that females demonstrated significantly increased negative activation (M=-3.50μV) towards violent images at the Fz site in comparison to males (M=-1.46μV) ($t=2.52$, $df=30$, $p=0.02$, $d=0.93$). This was also the case at the Fcz site (Males M=-1.20μV, Females M=-3.27μV) ($t=2.96$, $df=30$, $p<0.01$, $d=1.10$).

Across the 200ms epoch there was a main effect of sex at the Fz site ($F(1, 30) = 6.80$, $p = .01$, $\eta p2= .19$) towards violent ($t=2.28$, $df=30$, $p=0.01$, $d=0.82$) images. Females responded with an increased negative amplitude in comparison to males. A similar main effect for sex was found at the Fcz site ($F(1, 30) = 7.30$, $p = .01$, $\eta p2 = .20$) towards neutral images ($t=2.63$, $df=30$, $p=0.01$, $d=0.97$). Females responded with an increased negative amplitude.

Over the 300ms epoch there was one main effect of sex at the Pz site ($F(1, 30) = 6.19$, $p = .02$, $\eta p2 = .17$) towards violent images. Females ($M=14.18\mu V$) responded with a significantly increased positive activation ($t=-2.43$, $df=30$, $p=0.02$, $d=0.91$) in comparison to males ($M=6.60\mu V$). In addition, there was a significant main effect of image at the T7 site ($F(2, 60) = 5.99$, $p< .01$, $\eta p2 = .17$). Post hoc pairwise comparisons (adjusted for multiple comparisons) showed the difference to be between neutral ($M=4.32\ \mu V$) and violent ($M=0.94\mu V$) images ($p<0.01$, $d=0.76$).

Lastly, there was a significant main effect of sex on ERP activation over the LPP epoch for Pz site ($F(1, 30) = 4.89$, $p = .03$, $\eta p2 =.14$). However, post hoc independent t-test showed no significant results. There was a significant main effect of image at the T7 site ($F(2, 60) = 5.45$, $p< .01$, $\eta p2 = .15$). Post hoc pairwise comparisons (adjusted for multiple comparisons) showed the difference to be between neutral ($m=3.99\ \mu V$) and violent ($M=0.97\ \mu V$) images ($p<0.01$, $d=0.69$), and between erotic ($M=3.79\ \mu V$) and violent images ($p=0.02$, $d=0.60$).

This section of results has demonstrated that there were some significant sex differences in ERP activation towards emotive imagery. Across early epochs, females responded significantly more negatively across frontal regions (Fz and Fcz sites) towards neutral and violent images in comparison to males. Over later epochs, females demonstrated a significantly increased positive response towards violent images in comparison to males. Additionally, the main effects of image over both the 300ms and LPP epochs showed that there were significant differences in ERP activation between image categories. A visual representation of the sex differences has been provided using ERP graphs (see Figures 10 - 19).

Neutral
Violent
Erotic

Males

Females

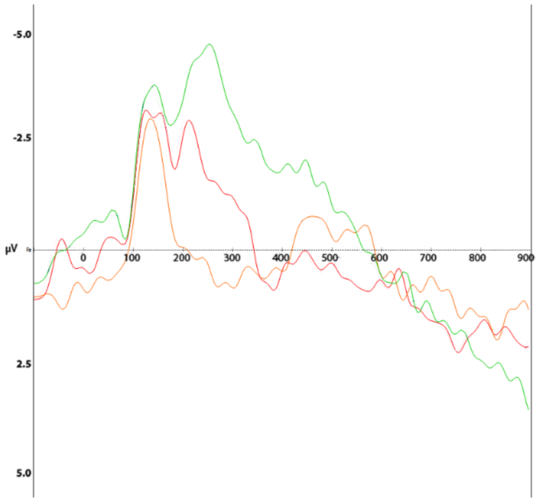


Figure 10. Grand average ERP waveform (microvolts) for males at the Fz location, across time (milliseconds).

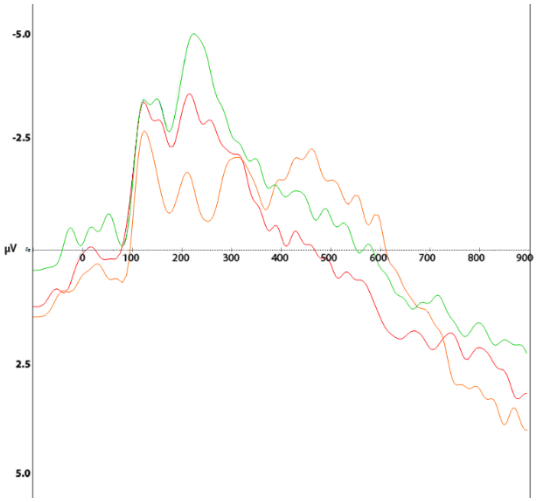


Figure 11. Grand average ERP waveform (microvolts) for females at the Fz location, across time (milliseconds).

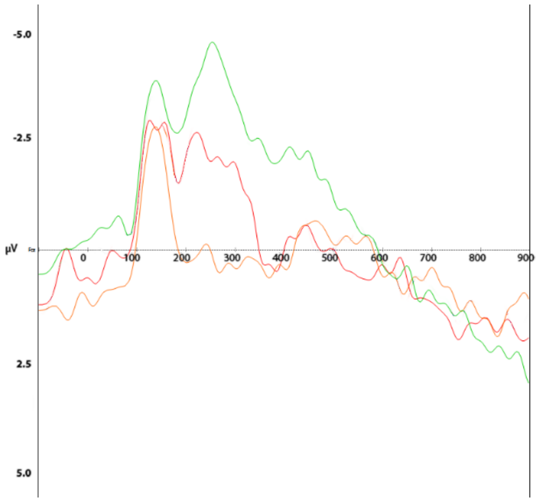


Figure 12. Grand average ERP waveform (microvolts) for males at the Fcz location, across time (milliseconds).

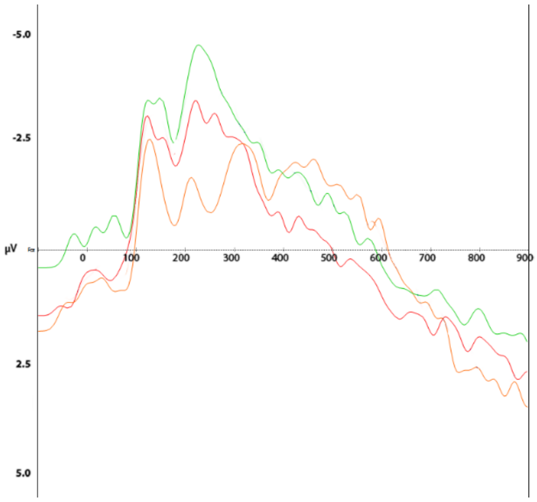


Figure 13. Grand average ERP waveform (microvolts) for females at the Fcz location, across time (milliseconds).

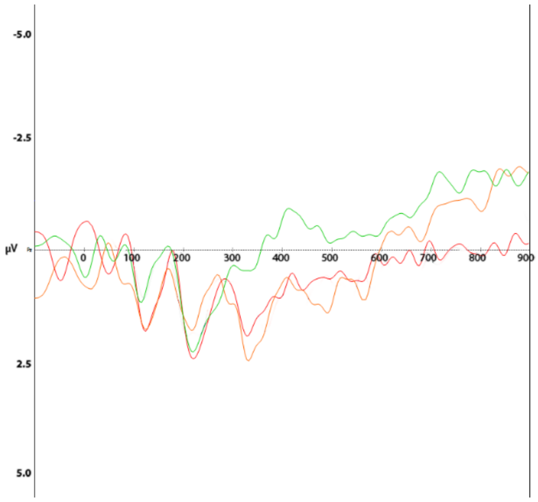


Figure 14. Grand average ERP waveform (microvolts) for males at the Pz location, across time (milliseconds).

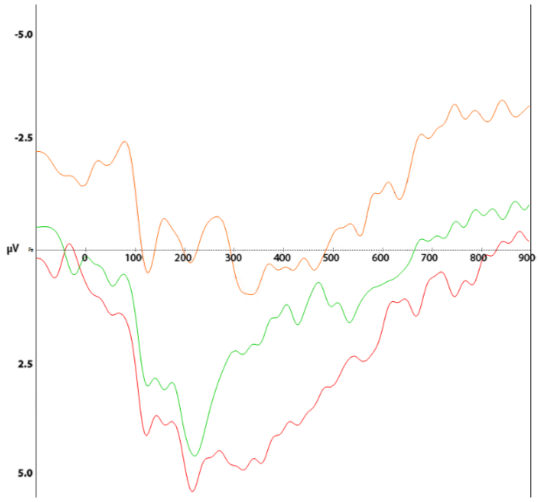


Figure 15. Grand average ERP waveform (microvolts) for females at the Pz location, across time (milliseconds).

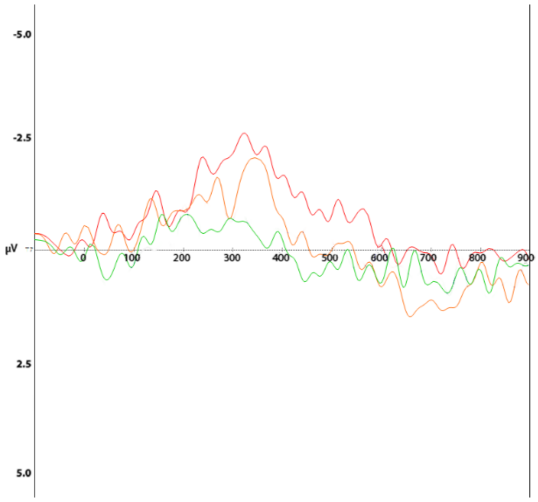


Figure 16. Grand average ERP waveform (microvolts) for males at the T7 location, across time (milliseconds).

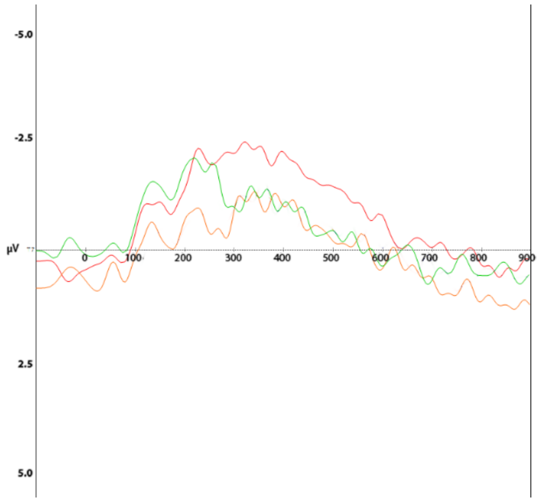
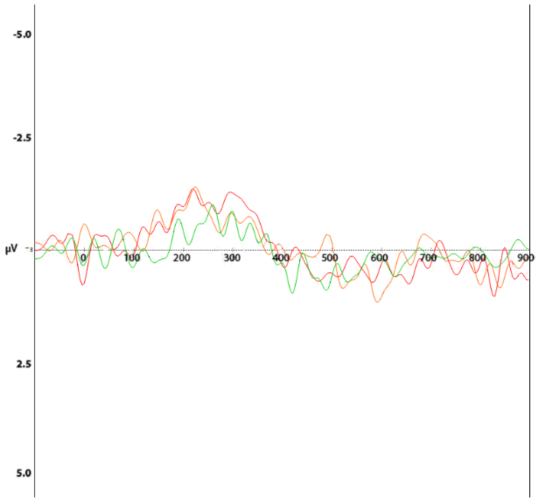


Figure 17. Grand average ERP waveform (microvolts) for females at the T7 location, across time (milliseconds).



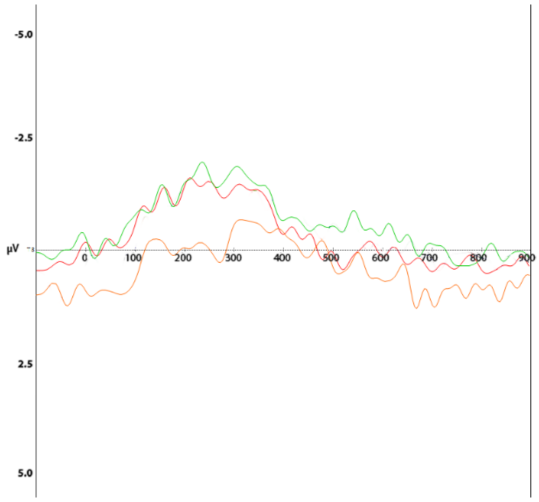


Figure 18. Grand average ERP waveform (microvolts) for males at the T8 location, across time (milliseconds).

Figure 19. Grand average ERP waveform (microvolts) for females at the T8 location, across time (milliseconds).

3.5.2 Section 2: Trait Aggression

Provided below is the analysis of trait aggression scores, measured using the BPAQ, by site and epoch for affective images. Self-report aggression was divided into dichotomous levels within the IV Total Trait Aggression Score; high aggression (scores of 81 and above on the BPAQ) and low aggression (scores under 81 on the BPAQ). The participant sample had low aggression females (LAF) (n=9), high aggression females (HAF) (n=9) and low aggression males (LAM) (n= 11) and only 3 high aggressive males (HAM). Therefore, to ensure there were no cell size violations (Field, 2013; Howell, 2013), all HAM data was removed from this analysis.

Standard descriptive statistics for LAF, HAF and LAM have been provided below (see Tables 10, 11, 12 and 14).

3.5.2.1 50 – 150ms Post Stimuli (100ms)

Table 10. Means and standard deviations of ERP amplitude, measured in microvolt's (uV), in relation to low and high trait aggression scores on the BPAQ for males and females, in response to affective images across the 100ms epoch.

100ms	Low Aggression Females		High Aggression Females		Low Aggression Males	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD
Fz						
Neutral	-3.48	3.38	-2.08	2.45	-1.63	2.02
Erotic	-2.89	3.79	-1.78	2.03	-2.13	1.59
Violent	-2.74	3.00	-4.26	2.28	-1.78	1.56
Fcz						
Neutral	-3.42	3.31	-2.12	1.99	-1.35	1.49

Erotic	-3.05	3.66	-1.45	1.70	-1.65	1.41
Violent	-2.65	2.84	-3.88	1.78	-1.36	1.18
Pz						
Neutral	0.47	5.56	1.58	2.05	0.64	1.71
Erotic	-0.31	5.98	-1.58	2.74	0.30	1.42
Violent	1.61	2.15	1.74	3.41	0.00	1.52
T7						
Neutral	-1.76	3.26	-0.45	1.96	0.88	1.66
Erotic	-0.30	3.75	0.41	0.87	-0.59	2.59
Violent	-1.59	2.95	-0.86	1.07	0.18	1.10
T8						
Neutral	-1.85	4.15	-0.49	2.15	0.19	1.65
Erotic	-0.20	3.09	0.48	1.76	0.47	2.03
Violent	-1.75	1.78	-0.49	1.59	0.11	1.52

3.5.2.2 150 – 250ms Post Stimuli (200ms)

Table 11. Means and standard deviations of ERP amplitude, measured in microvolt's (uV), in relation to low and high trait aggression scores on the BPAQ for males and females, in response to affective images across the 200ms epoch.

200ms	Low Aggression Females		High Aggression Females		Low Aggression Males	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD
Fz						
Neutral	-6.78	4.64	-5.39	2.28	-3.85	2.15
Erotic	-3.32	3.53	-3.53	2.17	-2.87	2.66
Violent	-4.31	2.99	-5.09	2.52	-2.66	2.55
Fcz						
Neutral	-6.42	4.26	-5.05	2.44	-3.26	1.86
Erotic	-3.20	3.39	-3.09	1.92	-2.40	2.19
Violent	-3.93	3.02	-4.81	2.38	-2.22	2.14

Pz						
Neutral	4.35	11.69	4.90	3.92	3.78	2.97
Erotic	0.68	8.76	0.60	7.84	1.68	2.06
Violent	5.56	5.97	6.78	5.27	2.66	3.54
T7						
Neutral	-3.81	3.82	-1.34	3.81	0.92	3.05
Erotic	-1.73	3.67	-0.20	2.25	-1.88	3.86
Violent	-2.91	3.03	-1.58	2.47	-0.78	2.88
T8						
Neutral	-2.76	5.78	-1.18	2.88	0.89	3.68
Erotic	-1.50	4.91	-0.91	1.58	-0.89	4.01
Violent	-1.49	2.60	-0.99	2.23	-0.38	3.49

3.5.2.3 250 – 450ms Post Stimuli (300ms)

Table 12. Means and standard deviations of ERP amplitude, measured in microvolt's (uV), in relation to low and high trait aggression scores on the BPAQ for males and females, in response to affective images across the 300ms epoch.

300ms	Low Aggression Females		High Aggression Females		Low Aggression Males	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD
Fz						
Neutral	0.87	8.43	1.85	4.05	1.04	3.17
Erotic	3.88	8.12	-0.64	6.59	2.30	5.85
Violent	1.55	6.30	2.17	2.98	3.89	4.54
Fcz						
Neutral	0.27	8.08	1.02	3.11	0.60	2.57
Erotic	2.88	8.04	-1.22	5.13	1.34	4.34
Violent	0.98	5.97	0.56	2.45	2.37	3.53
Pz						
Neutral	8.24	16.82	11.88	8.42	7.41	2.55

Erotic	6.30	14.01	9.44	10.45	6.82	4.71
Violent	12.10	10.13	16.30	12.13	6.99	4.59
T7						
Neutral	2.33	6.14	3.51	3.70	6.52	3.18
Erotic	2.65	5.78	2.99	4.53	2.98	4.15
Violent	0.07	4.92	0.89	4.38	1.60	4.26
T8						
Neutral	1.96	7.30	3.32	3.59	6.55	2.84
Erotic	2.53	7.69	3.86	4.99	4.33	3.98
Violent	2.79	3.95	4.46	3.79	4.99	4.72

3.5.2.4 400 – 800ms Post Stimuli (LPP)

Table 13. Means and standard deviations of ERP amplitude, measured in microvolt's (uV), in relation to low and high trait aggression scores on the BPAQ for males and females, in response to affective images across the LPP epoch.

LPP	Low Aggression Females		High Aggression Females		Low Aggression Males	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD
Fz						
Neutral	1.02	9.27	3.75	3.69	3.17	3.19
Erotic	6.60	10.59	2.43	5.60	2.31	4.94
Violent	3.47	6.62	4.36	3.16	4.70	4.32
Fcz						
Neutral	0.36	8.61	2.88	2.92	2.35	2.24
Erotic	4.94	10.74	1.39	4.56	1.52	3.64
Violent	2.49	6.26	2.66	3.20	3.16	3.19
Pz						
Neutral	6.90	18.61	12.15	11.38	6.04	2.39
Erotic	3.96	14.75	8.69	11.34	6.80	5.22
Violent	11.58	12.29	16.26	15.38	5.61	5.64

T7						
Neutral	2.09	6.29	3.06	3.97	6.45	2.69
Erotic	4.06	6.01	2.41	3.93	5.09	5.36
Violent	0.23	5.13	0.20	3.97	2.25	3.77
T8						
Neutral	0.81	8.16	3.66	2.84	6.22	3.50
Erotic	3.97	9.89	4.56	3.89	5.01	4.50
Violent	3.50	2.86	5.06	3.82	4.54	4.73

Section 2. data was analysed using two-way mixed method ANOVA's (Aggression, 3 levels: LAF, HAF, LAM x Image, 3 levels: Neutral, Violent and Erotic). Only significant results have been provided. Although there were no significant differences between HAF's and HAM's in mean amplitude towards any image category, across any epoch or site, there were significant differences found between groups (LAFs, LAM's and HAF's) using mixed ANOVA's.

Significant main effects of image were found over the 200ms epoch at the Fcz site ($F(2, 52) = 6.12$, $p< 0.01$, $\eta p2=.19$) and over the 300ms epoch at the T7 site ($F(2, 52) = 4.64$, $p= 0.01$, $\eta p2=.15$). Post hoc tests showed the differences over the 200ms epoch were non-significant post adjustment. Over the 300ms epoch for the T7 site, results showed the significant differences to be between neutral (M=4.12μV) and violent (M=0.85μV) images ($p<0.01$, $d=1.39$)

There was a significant main effect of aggression group on ERP activation over the 300ms epoch at the Pz site ($F(2, 52) = 3.66$, $p= 0.04$, $\eta p2=.14$). Post hoc tests showed the differences were non-significant post adjustment. Although this was the case, the ANOVA main effect showed the largest mean difference to be between LAM and HAF groups. This may extend the sex difference data. Over the LPP epoch there was a main effect of image at the T7 location ($F(2, 52) = 4.51$, $p= 0.02$, $\eta p2=.15$). Post hoc showed the differences to be between neutral (M=3.87μV) and violent (M=0.89μV) ($p=0.02$, $d=0.73$) and erotic (3.85μV) and violent images ($p=0.02$, $d=0.42$)

A visual representation of the differences between groups has been provided below in Figures 20 – 34.

Low Aggression Males (LAM)

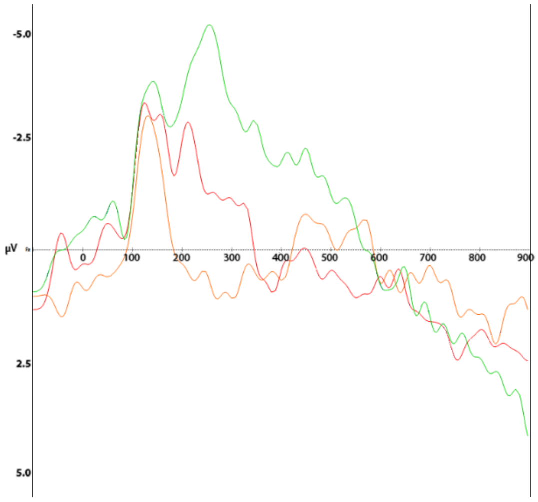


Figure 20. Grand average ERP waveform (microvolts) for LAM at the Fz location, across time (milliseconds).

Low Aggression Females (LAF)

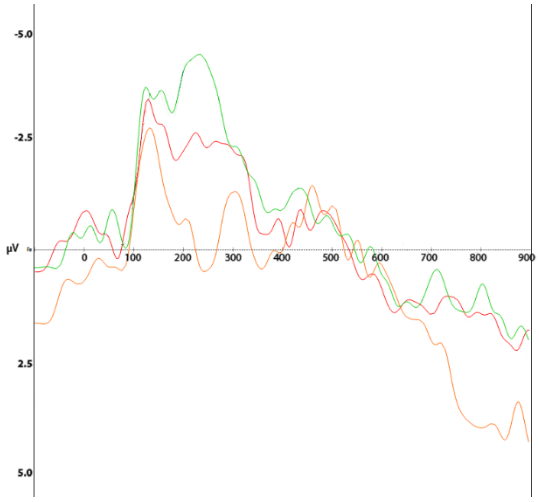


Figure 21. Grand average ERP waveform (microvolts) for LAF at the Fz location, across time (milliseconds).

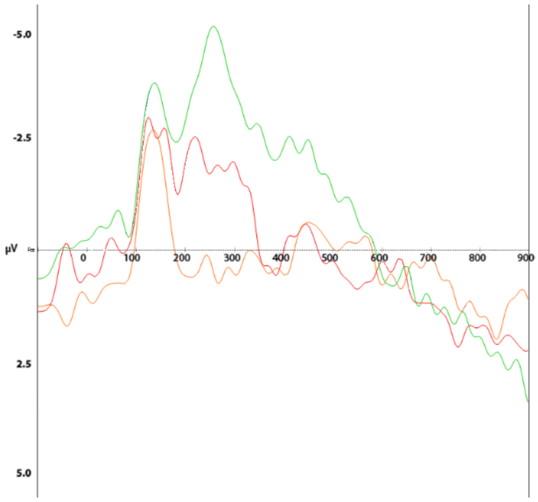


Figure 22. Grand average ERP waveform (microvolts) for LAM at the Fcz location, across time (milliseconds).

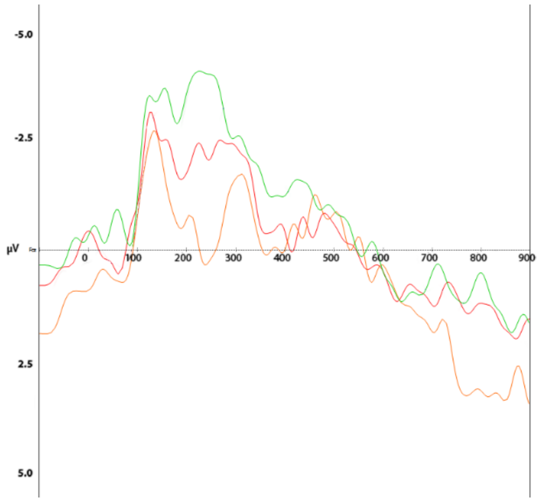


Figure 23. Grand average ERP waveform (microvolts) for LAF at the Fcz location, across time (milliseconds).

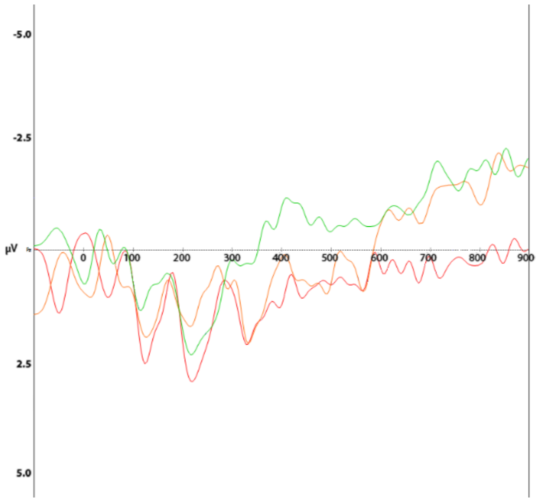


Figure 24. Grand average ERP waveform (microvolts) for LAM at the Pz location, across time (milliseconds).

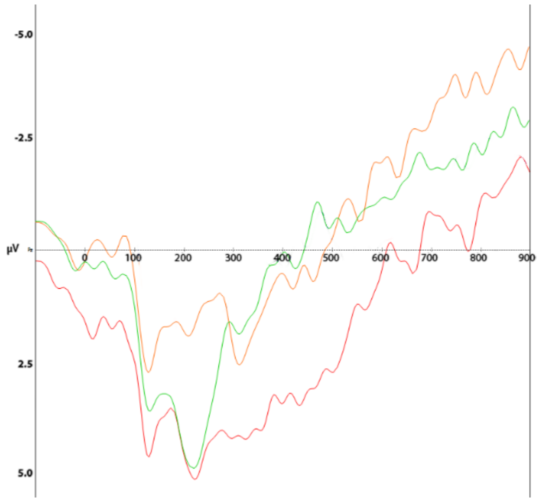


Figure 25. Grand average ERP waveform (microvolts) for LAF at the Pz location, across time (milliseconds).

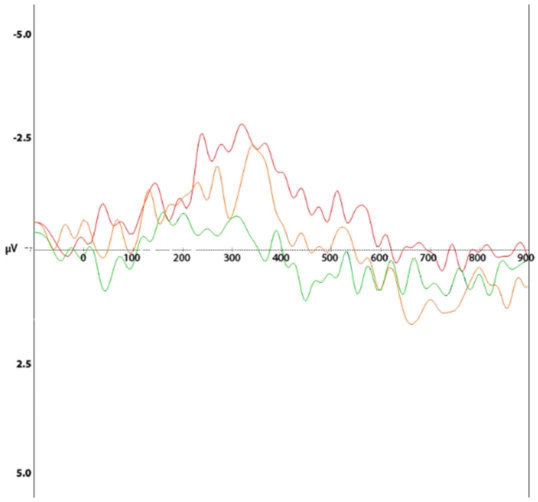


Figure 26. Grand average ERP waveform (microvolts) for LAM at the T7 location, across time (milliseconds).

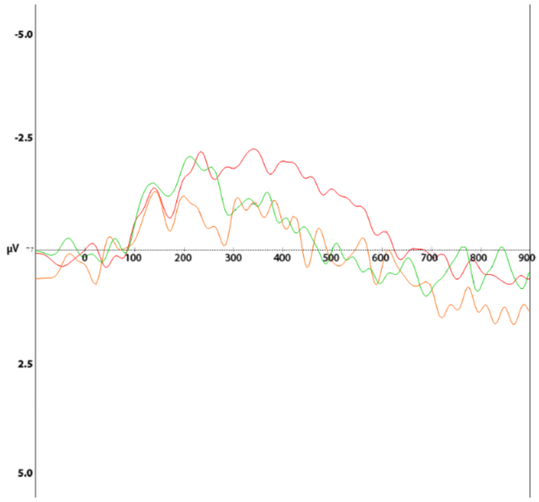
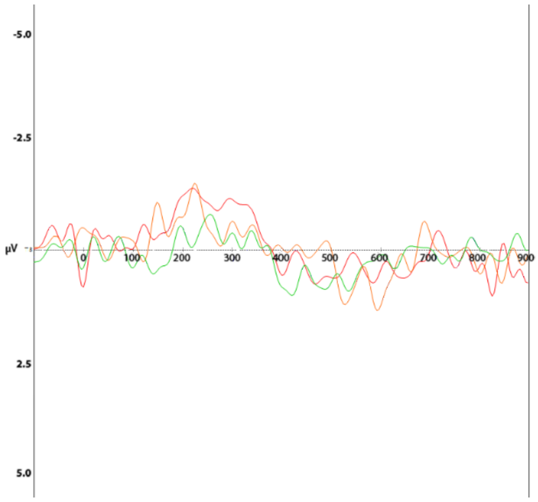


Figure 27. Grand average ERP waveform (microvolts) for LAF at the T7 location, across time (milliseconds).



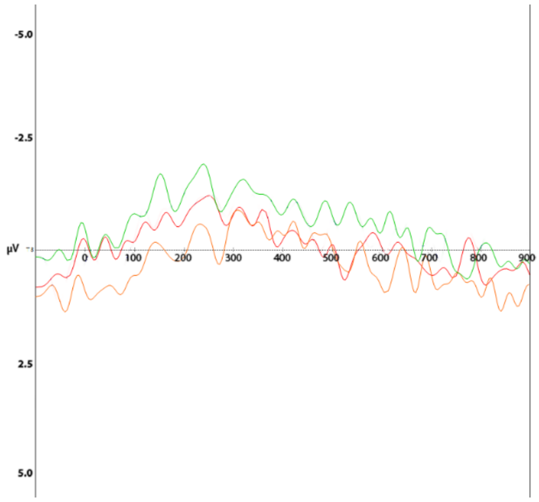


Figure 28. Grand average ERP waveform (microvolts) for LAM at the T8 location, across time (milliseconds).

Figure 29. Grand average ERP waveform (microvolts) for LAF at the T8 location, across time (milliseconds).

High Aggression Females (HAF)

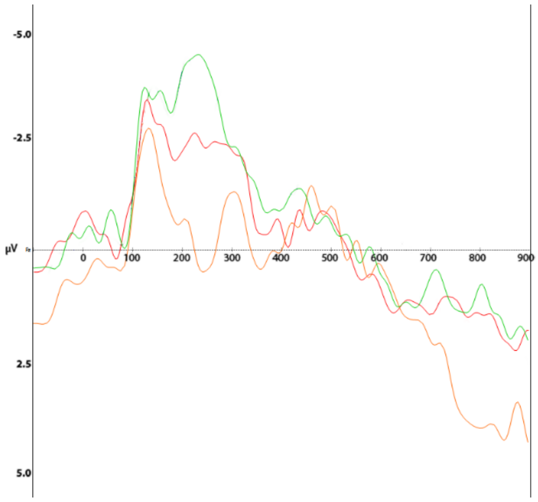


Figure 30. Grand average ERP waveform (microvolts) for LAF at the Fz location, across time (milliseconds).

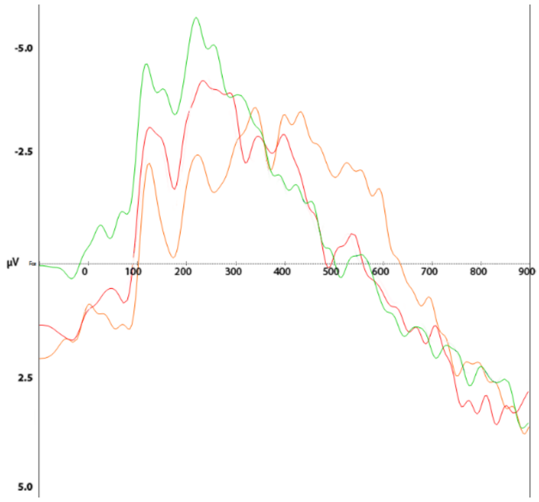


Figure 31. Grand average ERP waveform (microvolts) for LAF at the Fcz location, across time (milliseconds).

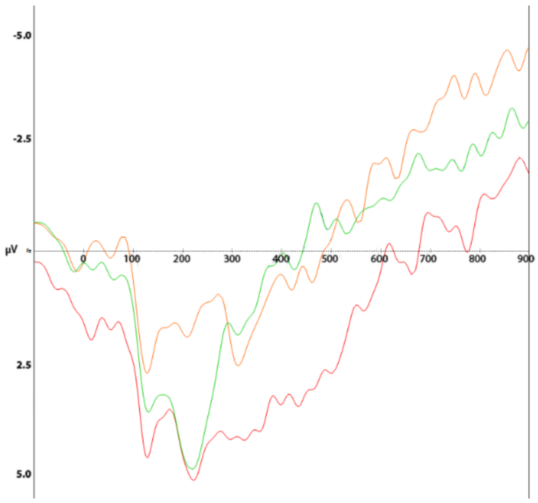


Figure 32. Grand average ERP waveform (microvolts) for LAF at the Pz location, across time (milliseconds).

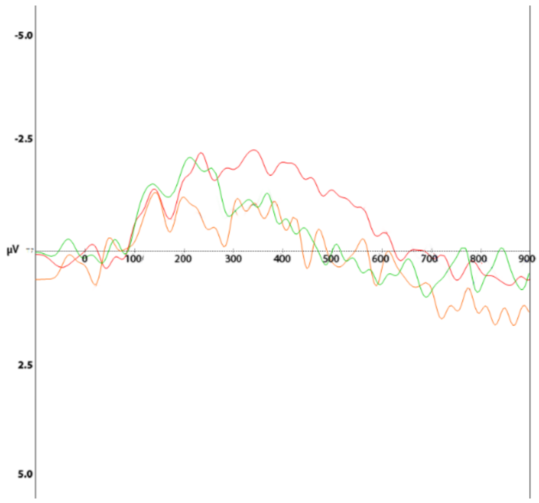


Figure 33. Grand average ERP waveform (microvolts) for LAF at the T7 location, across time (milliseconds).

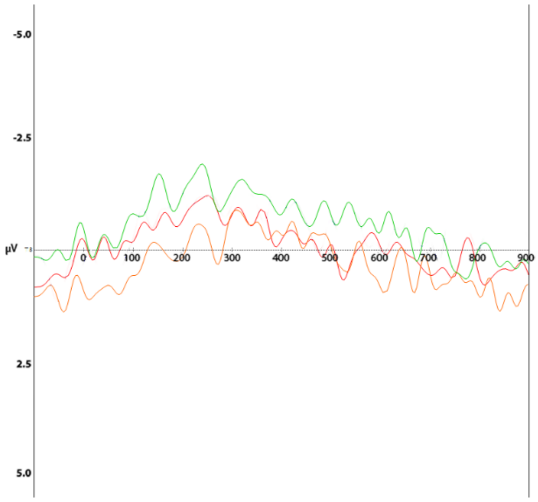


Figure 34. Grand average ERP waveform (microvolts) for LAF at the T8 location, across time (milliseconds).

3.5.3 Section 3: Witness or Victim of a Violent Crime

This is the analysis of previous life experience of violent crime (whether witness or victim) in relation to ERP amplitude by site and epoch in response to affective imagery. Descriptive data has been provided below (see Tables 14 -17).

3.5.3.1 50 – 150ms Post Stimuli (100ms)

Table 14.Means and Standard Deviations for ERP amplitudes, measured in microvolt's (uV), for participants who had been a witness or victim to a violent crime, in relation to affective images by site across the 100ms epoch.

100ms	Yes (n=18)		No (n= 14)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-1.81	2.04	-2.64	3.20
Erotic	-1.91	2.04	-2.47	2.91
Violent	-2.13	2.04	-3.22	2.86
Fcz				
Neutral	-1.70	1.80	-2.60	2.88

Erotic	-1.72	1.94	-2.26	2.76
Violent	-1.92	1.69	-2.93	2.65
Pz				
Neutral	1.24	2.41	0.24	4.06
Erotic	-0.68	2.54	-0.04	4.59
Violent	0.45	2.34	1.68	2.37
T7				
Neutral	0.27	1.12	-0.99	3.35
Erotic	-0.27	2.22	-0.12	2.91
Violent	-0.20	1.34	-0.92	2.52
T8				
Neutral	-0.22	1.60	-1.13	3.66
Erotic	0.34	1.80	-0.05	2.71
Violent	-0.04	1.45	-1.07	2.00

3.5.3.2 150 – 250ms Post Stimuli (200ms)

Table 15. Means and Standard Deviations for ERP amplitudes, measured in microvolt's (uV), for participants who had been a witness or victim to a violent crime, in relation to affective images by site across the 200ms epoch.

200ms	Yes (n=18)		No (n= 14)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-4.18	2.41	-5.94	4.06
Erotic	-3.16	2.42	-3.09	3.09
Violent	-3.53	2.32	-4.07	3.35
Fcz				
Neutral	-3.71	2.23	-5.66	3.81
Erotic	-2.75	2.12	-2.92	2.88
Violent	-3.03	1.98	-3.95	3.27
Pz				
Neutral	5.31	5.57	2.67	7.65

Erotic	0.96	5.35	1.24	7.28
Violent	5.24	5.96	3.88	3.83
T7				
Neutral	0.14	3.02	-2.20	4.74
Erotic	-1.48	3.67	-0.87	3.50
Violent	-0.69	2.58	-2.14	3.51
T8				
Neutral	0.75	3.12	-2.32	5.06
Erotic	-1.13	4.02	-1.26	3.82
Violent	-0.30	3.34	-1.50	2.60

3.5.3.3 250 – 450ms Post Stimuli (300ms)

Table 16. Means and Standard Deviations for ERP amplitudes, measured in microvolt's (uV), for participants who had been a witness or victim to a violent crime, in relation to affective images by site across the 300ms epoch.

300ms	Yes (n=18)		No (n= 14)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	1.26	3.68	1.17	6.87
Erotic	2.20	5.21	1.07	8.12
Violent	2.94	3.78	2.01	5.39
Fcz				
Neutral	0.42	3.04	0.77	6.46
Erotic	1.00	4.31	0.73	7.27
Violent	1.46	3.17	1.00	4.89
Pz				
Neutral	10.11	7.74	6.84	12.24
Erotic	6.54	7.00	8.43	11.96
Violent	11.41	10.09	10.18	8.86
T7				
Neutral	5.09	3.39	2.92	5.66

Erotic	2.05	3.77	3.57	5.50
Violent	2.24	3.31	-0.87	4.98
T8				
Neutral	5.91	3.48	1.54	5.66
Erotic	4.12	3.79	2.59	6.89
Violent	5.18	4.24	2.27	3.69

3.5.3.4 400 – 800ms Post Stimuli (LPP)

Table 17. Means and Standard Deviations for ERP amplitudes, measured in microvolt's (uV), for participants who had been a witness or victim to a violent crime, in relation to affective images by site across the LPP epoch

LPP	Yes (n=18)		No (n= 14)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	3.03	3.28	2.34	7.71
Erotic	3.12	4.04	3.81	9.79
Violent	4.27	3.79	3.66	5.48
Fcz				
Neutral	1.99	2.50	1.81	7.05
Erotic	1.91	3.23	2.96	9.29
Violent	2.63	3.08	2.62	5.18
Pz				
Neutral	9.56	9.75	5.70	13.51
Erotic	6.21	7.55	6.80	12.93
Violent	10.64	12.37	9.65	10.69
T7				
Neutral	4.80	3.39	2.95	5.77
Erotic	2.94	4.44	4.88	5.84
Violent	2.20	3.18	-0.61	4.87
T8				
Neutral	5.84	3.01	1.08	6.66

Erotic	4.40	3.83	4.35	8.39
Violent	4.81	4.17	3.34	3.39

Section 3. data was analysed using mixed ANOVA (Witness or Victim, 2 levels: Yes and No x Image, 3 levels: Neutral, Violent and Erotic). Only significant results have been provided.

There was a significant main effect of image on ERP activation over the 200ms epoch at the frontal recording sites Fz ($F(2, 60) = 4.87$, $p = 0.01$, $\eta p2 = .14$) and Fcz ($F(2, 60) = 6.13$, $p < 0.01$, $\eta p2 = .17$). Post hoc tests (Bonferroni) demonstrated that over the Fz site the differences were between neutral (M= -4.95 μV) and erotic (M= -3.13 μV) images (p=0.05, d=0.60). At the Fcz location, the differences were between neutral (M= -4.56 μV) and erotic (M= -2.83 μV) images (p=0.03, d=0.62) and between neutral (M= -4.56 μV) and violent (M= -3.43 μV) images (p=0.04, d=0.39).

A significant main effect of image was found over the 300ms epoch at the T7 site ($F(2, 30) = 6.34$, $p < 0.01$, $\eta p2 = .17$). Post hoc tests (Bonferroni) demonstrated that over the T7 site the differences were between neutral (M= 4.14 μV) and violent (M= 0.88 μV) images (p<0.01, d=0.73). Across the same location and epoch, there was an interaction between image and previous witness to a violent crime variable ($F(2, 30) = 3.36$, $p=0.04$, $\eta p2 = .10$) demonstrating that the ERP amplitude was inconsistent across group.

It was considered that there may be a need to have used 2 x 2 ANOVA to analyse any differences for where participants had been a victim and a witness of a violent crime. However, there were only 4 reported occasions where this was the case and therefore the cell size would have violated the assumptions of the test (Field, 2013).

3.5.4 Section 4: Preference Towards Playing Violent or Non-Violent Video Games

This section outlines the analysis of previous lifestyle choices (preferences toward playing violent or non-violent videogames) in relation to ERP amplitude by site and epoch, in response to affective imagery. Descriptive data has been provided below (see Tables 18-21.)

3.5.4.1 50 – 150ms Post Stimuli (100ms)

Table 18. Means and Standard Deviations for ERP amplitudes, measured in microvolt's (uV), for participants who preferred playing videogames of violent or non-violent content, in relation to affective images by site across the 100ms epoch.

100ms	Violent (n=8)		Non-Violent (n=24)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-1.30	1.55	-2.46	2.83
Erotic	-2.18	1.86	-2.15	2.63
Violent	-1.99	1.74	-2.81	2.65
Fcz				
Neutral	-1.44	1.96	-2.30	2.45
Erotic	-2.07	2.44	-1.92	2.32
Violent	-1.76	1.38	-2.56	2.39
Pz				
Neutral	1.60	3.23	0.54	3.24
Erotic	-1.34	3.23	-0.09	3.63
Violent	-0.37	2.24	1.44	2.32
T7				
Neutral	0.78	1.84	-0.64	2.50
Erotic	-1.14	2.71	0.11	2.41
Violent	-0.14	1.20	-0.64	2.14
T8				
Neutral	0.32	1.92	-0.93	2.86
Erotic	0.12	1.97	0.19	2.33
Violent	-0.39	1.50	-0.52	1.87

3.5.4.2 150 – 250ms Post Stimuli (200ms)

Table 19. Means and Standard Deviations for ERP amplitudes, measured in microvolt's (uV), for participants who preferred playing videogames of violent or non-violent content, in relation to affective images by site across the 200ms epoch.

200ms	Violent (n=8)		Non-Violent (n=24)	

Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-4.03	2.26	-5.25	3.57
Erotic	-2.73	2.76	-3.26	2.71
Violent	-3.08	2.22	-3.99	2.95
Fcz				
Neutral	-3.40	2.34	-4.95	3.30
Erotic	-2.60	2.45	-2.90	2.49
Violent	-2.62	1.97	-3.70	2.78
Pz				
Neutral	6.17	7.75	3.48	6.19
Erotic	1.44	3.75	0.96	6.84
Violent	3.82	5.71	4.92	5.00
T7				
Neutral	-0.13	2.90	-1.14	4.30
Erotic	-1.78	4.38	-1.03	3.32
Violent	-1.11	2.88	-1.39	3.17
T8				
Neutral	0.59	3.64	-0.99	4.49
Erotic	-0.72	4.93	-1.35	3.56
Violent	-0.73	3.60	-0.86	2.93

3.5.4.3 250 – 450ms Post Stimuli (300ms)

Table 20. Means and Standard Deviations for ERP amplitudes, measured in microvolt's (uV), for participants who preferred playing videogames of violent or non-violent content, in relation to affective images by site across the 300ms epoch

300ms	Violent (n=8)		Non-Violent (n=24)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	2.08	3.02	0.93	5.80

Erotic	3.37	4.71	1.14	7.05
Violent	3.82	1.88	2.11	5.05
Fcz				
Neutral	1.11	3.16	0.39	5.23
Erotic	1.57	3.51	0.66	6.30
Violent	1.81	1.20	1.08	4.52
Pz				
Neutral	10.49	8.50	8.08	10.44
Erotic	7.90	4.72	7.19	10.56
Violent	8.15	4.94	11.78	10.45
T7				
Neutral	5.24	3.00	3.77	4.99
Erotic	1.63	3.39	3.08	4.93
Violent	1.55	4.74	0.65	4.29
T8				
Neutral	6.89	3.48	3.04	5.11
Erotic	4.40	4.93	3.13	5.52
Violent	4.45	4.63	3.73	4.16

3.5.4.4 400 – 800ms Post Stimuli (LPP)

Table 21. Means and Standard Deviations for ERP amplitudes, measured in microvolt's (uV), for participants who preferred playing videogames of violent or non-violent content, in relation to affective images by site across the LPP epoch

LPP	Violent (n=8)		Non-Violent (n=24)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	3.70	2.83	2.40	6.23
Erotic	2.55	4.44	3.72	7.75
Violent	4.42	1.65	3.87	5.18
Fcz				
Neutral	2.52	2.65	1.71	5.52

Erotic	1.09	3.21	2.79	7.27
Violent	2.21	1.34	2.76	4.64
Pz				
Neutral	9.87	8.63	7.20	12.41
Erotic	7.24	4.81	6.21	11.38
Violent	5.15	4.39	11.89	12.66
T7				
Neutral	5.51	1.98	3.48	5.12
Erotic	3.80	2.96	3.79	5.70
Violent	2.16	3.85	0.58	4.29
T8				
Neutral	6.41	4.12	2.87	5.58
Erotic	5.54	4.27	3.99	6.67
Violent	4.05	4.59	4.21	3.70

Section 4. data was analysed using mixed ANOVA (preference towards playing VVG, 2 levels: VVG and NVVG x Image, 3 levels: Neutral, Violent and Erotic). Only significant results have been provided.

There were no main effects of VVG preference. There was a significant main effect of image on ERP activation over the 300ms epoch at the T7 site ($F(2, 60) = 4.70$, $p =0.03$, $\eta p2=.14$). Post hoc tests (Bonferroni) demonstrated that the differences were between neutral (M= 4.51 μV) and violent (M= 1.10 μV) images ($p=0.03$, $d=0.60$). A significant main effect of image was also found over the LPP epoch at the T7 site ($F(2, 30) = 3.81$, $p =0.03$, $\eta p2=.11$). Post hoc tests (Bonferroni) demonstrated that over the T7 site the differences were between neutral (M= 4.50μV) and violent (M= 1.37 μV) images ($p=0.02$, $d=0.71$). This suggested that there were significant differences in response towards neutral and violent content at the T7 site over both the 300ms and LPP epochs. Violent content evoked a reduced response at T7 site over later epochs in comparison to neutral stimuli.

3.5.5 Section 5: Preference Towards Watching Violent or Non-Violent Films

This is the analysis of previous lifestyle choices (preferences toward watching violent or nonviolent film media) in relation to ERP amplitude by site and epoch, in response to affective imagery. Descriptive data has been provided below (see Tables 22-25.)

3.5.5.1 50 – 150ms Post Stimuli (100ms)

Table 22. Means and Standard Deviations for ERP amplitudes, measured in microvolt's (uV), for participants who preferred films with violent or non-violent content, in relation to affective images, by site, across the 100ms epoch

100ms	Violent (n=15)		Non-Violent (n=17)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-1.45	2.07	-2.81	2.90
Erotic	-2.01	1.79	-2.29	2.93
Violent	-1.97	1.95	-3.17	2.77
Fcz				
Neutral	-1.33	1.63	-2.76	2.70
Erotic	-1.75	1.48	-2.14	2.89
Violent	-1.65	1.66	-2.99	2.44
Pz				
Neutral	0.48	2.57	1.09	3.76
Erotic	-0.50	2.52	-0.32	4.31
Violent	1.48	3.09	0.55	1.54
T7				
Neutral	0.65	1.54	-1.11	2.76
Erotic	0.16	1.69	-0.52	3.06
Violent	-0.24	1.39	-0.76	2.34
T8				
Neutral	0.18	1.52	-1.32	3.29
Erotic	0.62	1.15	-0.22	2.82
Violent	-0.24	1.20	-0.71	2.16

3.5.5.2 150 – 250ms Post Stimuli (200ms)

Table 23. Means and Standard Deviations for ERP amplitudes, measured in microvolt's (uV), for participants who preferred films with violent or non-violent content, in relation to affective images, by site, across the 200ms epoch.

200ms	Violent (n=15)		Non-Violent (n=17)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-3.67	2.89	-6.07	3.31
Erotic	-2.57	2.18	-3.62	3.05
Violent	-2.69	2.71	-4.72	2.55
Fcz				
Neutral	-3.39	2.62	-5.60	3.24
Erotic	-2.24	1.91	-3.33	2.79
Violent	-2.30	2.44	-4.43	2.41
Pz				
Neutral	3.96	3.45	4.32	8.58
Erotic	1.79	4.17	0.46	7.58
Violent	4.73	4.37	4.57	5.82
T7				
Neutral	0.12	3.79	-1.77	4.03
Erotic	-0.81	3.00	-1.58	4.03
Violent	-0.43	2.99	-2.11	2.98
T8				
Neutral	1.19	3.55	-2.17	4.37
Erotic	-0.11	3.12	-2.14	4.30
Violent	0.46	2.59	-1.95	3.05

3.5.5.3 250 – 450ms Post Stimuli (300ms)

Table 24. Means and Standard Deviations for ERP amplitudes, measured in microvolt's (uV), for participants who preferred films with violent or non-violent content, in relation to affective images, by site, across the 300ms epoch

300ms	Violent (n=15)		Non-Violent (n=17)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	3.42	4.11	-0.72	5.43
Erotic	4.60	5.38	-0.86	6.54
Violent	4.15	5.24	1.11	3.26
Fcz				
Neutral	2.56	3.48	-1.18	5.13
Erotic	2.99	4.96	-0.97	5.78
Violent	2.51	4.93	0.16	2.48
Pz				
Neutral	6.96	4.79	10.19	12.85
Erotic	7.49	4.66	7.26	12.29
Violent	9.97	7.48	11.67	11.06
T7				
Neutral	5.46	4.08	2.98	4.79
Erotic	2.72	4.19	2.72	5.04
Violent	1.13	4.47	0.66	4.35
T8				
Neutral	5.45	4.17	2.72	5.43
Erotic	3.81	3.58	3.13	6.60
Violent	4.16	3.24	3.68	5.01

3.5.5.4 400 – 800ms Post Stimuli (LPP)

Table 25. Means and Standard Deviations for ERP amplitudes, measured in microvolt's (uV), for participants who preferred films with violent or non-violent content, in relation to affective images, by site, across the LPP epoch

LPP	Violent (n=15)		Non-Violent (n=17)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	4.25	3.80	1.38	6.58
Erotic	4.71	1.81	2.91	1.45
Violent	4.74	5.45	3.35	3.59
Fcz				
Neutral	3.27	3.08	0.71	5.96
Erotic	3.10	4.92	1.71	5.65
Violent	3.29	4.96	2.03	3.08
Pz				
Neutral	5.54	5.44	9.91	7.86
Erotic	6.81	4.45	6.17	13.38
Violent	9.07	9.13	11.21	13.43
T7				
Neutral	5.31	3.72	2.82	5.07
Erotic	3.58	4.59	3.97	5.65
Violent	1.14	4.17	0.83	4.31
T8				
Neutral	4.71	4.72	2.92	5.98
Erotic	3.73	3.89	4.95	7.67
Violent	3.86	3.45	4.43	4.28

Section 5. data was analysed using mixed ANOVA (preference towards watching VF, 2 levels: Violent and Non-violent x Image, 3 levels: Neutral, Violent and Erotic). Only significant results have been provided.

There was a significant main effect of image on ERP activation over the 200ms epoch at the Fz site ($F(2, 60) = 4.10$, $p = 0.02$, $\eta p2 = .12$).

However, post hoc tests (Bonferroni) showed no significant results. A significant main effect of film preference was also found over the 200ms epoch, Fz site ($F(1, 30) = 7.16$, $p = 0.01$, $\eta p2 = .19$). An adjusted independent t-test showed that there were no significant results.

There was also a significant main effect of image on ERP activation over the 200ms epoch at the Fcz site ($F(1, 60) = 5.18$, $p<0.01$, $\eta p2 = .15$). However, post hoc tests (Bonferroni) showed no significant results. A significant main effect of film preference was also found over the 200ms epoch, Fcz site ($F(1, 30) = 6.93$, $p = 0.01$, $\eta p2 = .19$). However, post hoc tests (Bonferroni) showed no significant results. A significant main effect of film preference was also found over the 200ms epoch, Fcz site ($F(1, 30) = 6.93$, $p = 0.01$, $\eta p2 = .19$). An adjusted independent t-test showed a significant difference in response towards violent ($t=2.48$, $df=30$, $p=0.02$, $d=0.60$) images. Those in the NV group responded with an increased negativity. A significant main effect of film preference was also found over the 200ms epoch, T8 site ($F(1, 30) = 6.93$, $p = 0.01$, $\eta p2 = .19$). An adjusted independent t-test showed a significant difference in response towards violent ($t=2.36$, $df=30$, $p=0.02$, $d=0.84$) and neutral ($t=2.36$, $df=30$, $p=0.02$, $d=0.85$) images. Those in the NV group responded with an increased negativity in comparison to the positive amplitude for those in the violent film preference group.

Over the 300ms epoch there was a significant main effect of film preference at the Fz site ($F(1, 30) = 15.42$, $p < 0.001$, $\eta p2 = .34$). An adjusted independent t-test showed a significant difference in response towards neutral ($t=2.40$, $df=30$, $p=0.02$, $d=0.86$) and erotic ($t=2.56$, $df=30$, $p=0.02$, $d=0.92$) images. Those in the violent film preference group responded with a significantly increased positive mean amplitude in comparison to the negative response for those in the NV film preference group. Similarly, a significant main effect of film preference was found at the Fcz site ($F(1, 30) = 10.84$, $p < 0.001$, $\eta p2 = .27$). An adjusted independent t-test showed a significant difference in response towards neutral ($t=2.38$, $df=30$, $p=0.02$, $d=0.56$) images. Those in the violent film preference group responded with a significantly increased positive mean amplitude in comparison to the negative response for those in the NV film preference group. Additionally, there was a significant main effect of image found at the T7 site ($F(2, 60) = 5.82$, $p < 0.01$, $\eta p2 = .16$). Post hoc tests (Bonferroni) demonstrated that over the T7 site the differences were between neutral ($M= 4.22$ μV) and violent ($M= 0.89$ μV) images ($p<0.01$, $d=0.73$)

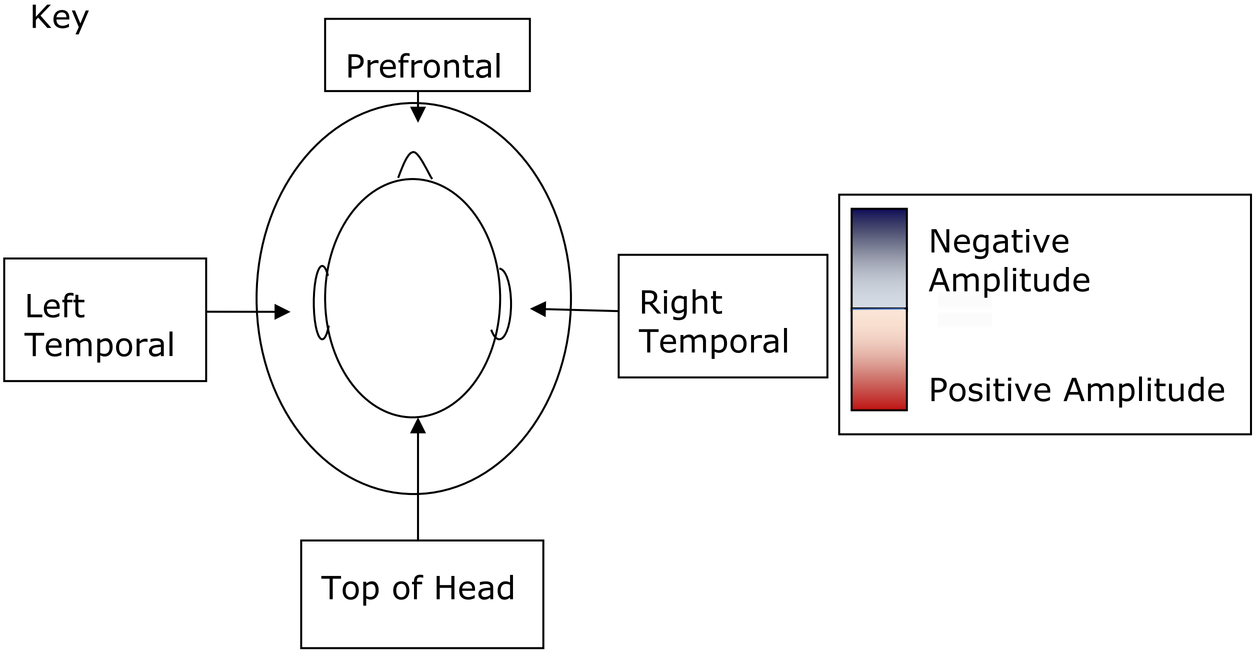
Lastly, there was a significant main effect of Film preference on ERP activation over the LPP epoch for Fz site ($F(1, 30) = 6.45$, $p = .02$,

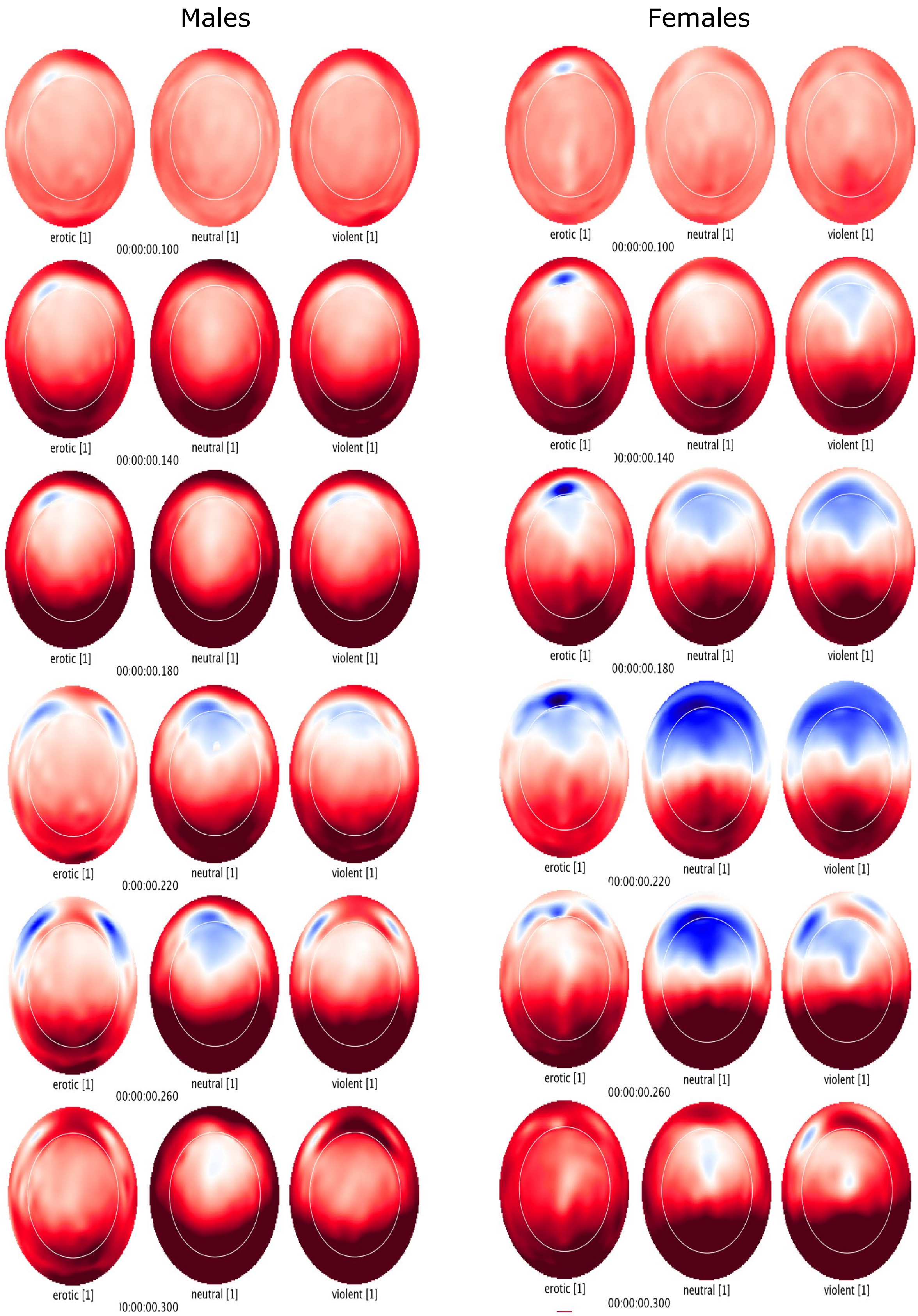
$\eta p2$=.18). However, post hoc independent t-test showed no significant results. There was also a significant main effect of image at the T7 site ($F(2, 60) = 5.58$, $p < .01$, *$\eta p2$*= .16). Post hoc pairwise comparisons (adjusted for multiple comparisons) showed the difference to be between neutral (m=3.99 μV) and violent (M=0.97 μV) images ($p<0.01$, $d=0.69$), and between erotic (M=3.79 μV) and violent images ($p=0.01$, $d=0.60$).

3.5.6 Section 6: Topoplots – A Visual Display of Cortical Activation.

Presented below (Figure 35.) is a sample visual representation of the grand averaged ERP activation across male and female cortices in response to the differing image categories (for full topoplot timeframe images, see Appendix AE for full details). It is evident that there are marked sex differences in response to the stimuli over time. Overall, females appeared to have demonstrated an increased early negativity across frontal sites that continued across all epochs and image categories, in frontal regions and an intense area of positive activation approximately around the Pz measurement site to violent images. This is in comparison to males who predominantly demonstrated positive activation except from an intense area of negativity in the frontal left region towards violent images. Females demonstrated a vertical band of negative activation down the z-line and moderate negativity in the prefrontal regions towards erotic images in comparison to positivity or slight negativity found in the prefrontal regions for males. Using this imaging technique, it has illustrated overall sex differences in activation to differing content.

Key

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violent [1]

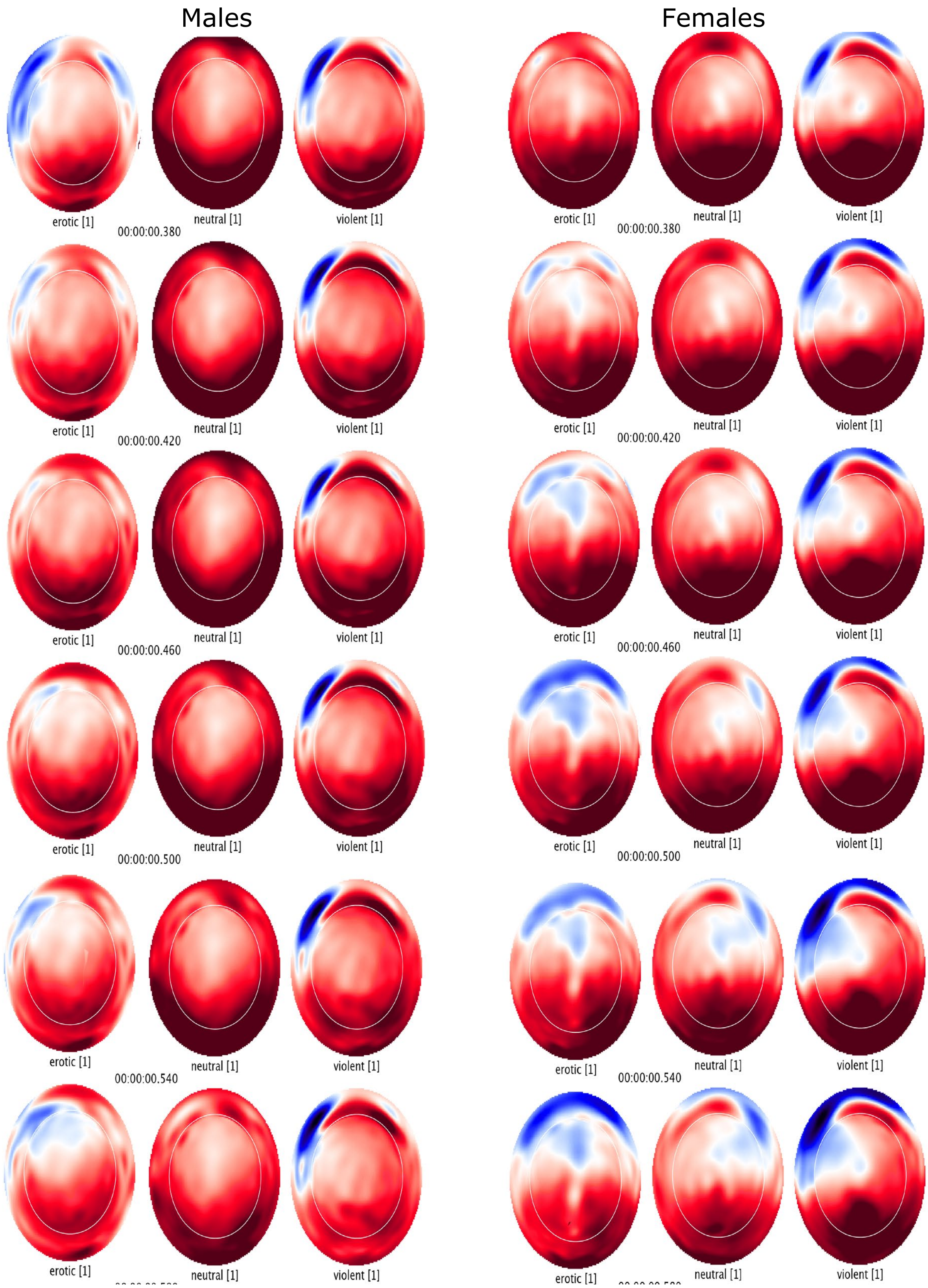


Figure 35. Visual representation of the grand averaged ERP activation across the male and female cortices in response to the differing image categories.

3.6 Discussion

There were three main aims of this research; to investigate potential differences in emotional processing due to exposure to violent media; to investigate the potential differences in emotional processing due to alternative factors (e.g. sex and previous life experiences) and to investigate differences between published research data and the results from this pilot study to provide a baseline for further research. The results showed differences in emotional processing of emotive images based on preference towards watching violent films but not for preference towards violent videogames. Furthermore, there was no evidence to support research and theory suggesting that exposure to violent media desensitizes emotional processing and response towards violent stimuli (e.g. Engelhardt et al., 2011). This research found opposite findings; increased response towards violent stimuli. Suggesting that content of interest may evoke an increased response based on preference towards violent media. However, there were differences in emotional processing of visual stimuli moderated by sex, preference towards violent films, trait aggression and previous experience of being a witness or victim of a violent crime. Thus, this suggested that alternative factors had a moderating effect on processing of emotive visual stimuli.

The following section has been divided into 5 subsections. The first discusses the results in relation to the literature from a global perspective and focuses on the general trends from the analysis. The following three subsections have focused on specific stimuli content (Violent, Erotic and Neutral) and thereafter, a summary has been provided. This should enable the reader to map both results section findings with the expected results based on theoretical projections and previous empirical findings from all independent variable perspectives (i.e. sex differences, aggression, previous life experience, preference and finally, image category).

3.6.1 Overall Trends (Non-Category Specific)

Traditionally, an enhanced ERP amplitude has been observed towards content considered salient or emotive (i.e. violent or erotic) in comparison to neutral (e.g. Schupp et al., 2000; 2004). Overall, this exploratory research supported this finding, in general, there were increased ERP mean amplitudes recorded for emotive content in comparison to neutral (see Table 6-25.) and there were several main effects of image found across the different sections. However, only a few occasions where differences in response was significant between neutral and salient/emotive content. It has been suggested that evolutionary salient stimuli evoke increased attentional resources (e.g. Schupp et al., 2003) understood to be required for processing in the event of threat and reproduction.

In addition, female participants demonstrated an increased negativity across early components and measurement sites in comparison to male participants. Interestingly, this was found across all image categories not just those considered negative or emotional (Lithari et al., 2010). Thus, this research adds to the current literature of sex differences in emotional processing and neurobiology (Glaser et al., 2012; Lusk et al., 2017; Lykins et al., 2008; Ruigrok et al., 2014; Rupp & Wallen, 2008; Victor et al., 2017). Furthermore, these findings supported research suggesting that females have an early negativity bias towards emotive stimuli (e.g. Gardener et al, 2013; Lithari et al, 2010) and are more responsive towards affective imagery, especially where the content is danger-focused (Filkowski et al., 2017; Han et al., 2008; Kempton et al., 2009; Kim et al., 2013; Lee, Kim, Shim, & Lee, 2017; Polackova & Lacev, 2017; Whittle et al., 2011). However, previous research has found the most pronounced sex differences appeared in central and left frontal regions (e.g. Lithari et al,.2011). The current research found that frontal regions showed most prominent differences. Thus, future research should incorporate frontal and a central region measurement site to ensure no cross over effect took place within this experiment.

In general, an increased positivity was demonstrated across the 300ms and LPP epochs at the Pz cluster site towards affective imagery categories. This supported research suggesting that emotive visual stimuli evoked increased ERP amplitudes over later epochs (e.g. Godleski et al. 2010; Hajcak, MacNamara & Olvet, 2010; Schupp, 2000). Females demonstrated an increased positivity in comparison to males across the later epochs, at the Pz site and in line with Garderner et al. (2013) findings, this could support the theory that females have an increased upregulation of emotional response evoked toward negative visual stimuli.

There were several significant differences found over temporal measurement clusters (i.e. T7 and T8). The temporal lobes and a region in the fusiform gyrus have been associated with facial recognition and processing (Furl, Garrido, Dolan, Driver, & Duchaine, 2011; Iidaka, 2014). The N170 component that peaks over the occipito-temporal region (Caharel, Collet, & Rossion, 2015; Rossion, 2014) has been viewed as a reliable marker of facial representation and processing (Caharel et al., 2015). The N170 has been evoked by various facial formats (e.g. for reviews Rossion, 2014) and a reduced N170 amplitude has been seen when the same face was presented in comparison to varying face stimuli irrespective of chances in viewpoint or angle (e.g. Cacharel, d'Arrive, Ramon, Jacques, & Rossion, 2009; Cacharel, Jacques, d'Arrive, Ramon, & Rossion, 2011). It has been suggested that processing and attention is directed and focused towards faces and figures in comparison to scenes (Clayson & Larson, 2013; Fletcher-Watson et al., 2008; Nordström & Wiens, 2012; Schupp et al., 2003). Thus, activation towards different image categories could have been influenced by the potentially unbalanced proportion of images where faces and figures were present.

Additionally, there has been evidence showing increased activation in the right temporal lobe and amygdala in females viewing emotive faces (Kempton et al., 2009). Thus, this could suggest that the sex differences in mean ERP amplitude found at temporal sites could be related to images containing figures and faces, especially those with emotional depictions (e.g. violent). This further highlighted the need for additional investigation into content and context specific stimuli in relation to media effects. These preliminary findings suggested that there are methodological issues with research and theory that failed to identify sex as a defining factor (e.g. Engelhardt et al. 2011) or has regarded sex as homogeneous (e.g. Barthelow et al, 2006) when investigating media effects.

Lastly, the IAPS images are a predefined database of approximately 1000 images to be used for research (Bradley & Lang, 2015; Lang et al., 2008). However, due to the minimal number of images per category, the images do not allow for cross cultural differences (e.g. Balas, Westerlund, Hung, & Nelson, 2011; Eberhardt, Goff, Purdie, & Davies, 2004). This was a potential confound within this research and should be identified as an important factor for future research.

3.6.2 Violent Category Content

Overview: As was evident from viewing the topoplot images (see Ch. 3.6.6 for summary and Appendix AE for full details), activation towards violent imagery appeared to begin around 100 – 140ms post stimuli presentation with distinct negativity in the frontal regions (Fz and Fcz). A change to positive activation around 300ms post stimuli presentation was observed across the cortices except for frontal regions for females and left anterior area for both sexes. Females demonstrated an area of negativity that developed in the left anterior cortical region from approximately 340ms post stimuli presentation that subsequently appeared to spread across frontal areas. Males displayed a similar area of negativity in left anterior region however, the intensity contrasted to that of the female response and the negative activation did not appear to extend towards frontal cortical areas, unlike female participants. Posterior regions showed positive activation towards violent content however, females developed an increased area of activity around central posterior sites (e.g. Pz) that appeared to remain throughout the epoch in comparison to males.

There were several sex differences in response towards the violent image category across epoch and measurement site. Females tended to respond with an increased negativity over early epochs across measurement sites, followed by an increased positivity over the 300ms and LPP epochs at the Pz site in comparison to males. Females appeared to respond with maximal mean ERP amplitude (either negative or positive) in relation to violent content compared to males. This supported research suggesting that females tend to be more responsive towards emotive content than males (e.g. Anokhin et al., 2006; Lithari et al., 2010; Filkowski, Olsen, Duda, Wanger, & Sabatinelli, 2017; van Hooff, Crawford, & van Vugt, 2011), especially when danger focused. However, no direct evidence was provided, in either direction, for theory and research suggesting that VM has a detrimental effect on neurological response.

There was inconsistency with regards to increasing aggression and VM exposure (Bartholow et al., 2006; Engelhardt, Bartholow, Kerr, et al., 2011; Engelhardt, Bartholow, & Saults, 2011; Ferguson & Rueda, 2009; Ferguson, Smith, et al., 2008; Jerabeck & Ferguson, 2013). The results clearly showed that there were significant differences in early response at frontal and temporal sites towards violent images in relation to trait aggression. However, the differences were found between LAF and LAM groups and therefore may extend support for the early negativity bias for females (Lithari et al, 2010) rather than demonstrate a difference potentially moderated by aggression score. As no within sex differences were found (i.e. between groups HAF and LAF), it suggested that trait aggression did not modulate response towards violent imagery for females. However, due to the fact that it was not possible to recruit high scoring males, additional investigation is required to examine the male response.

Furthermore, the results of the current study showed that participants in the HAF group responded with an increased positive mean amplitude in the 300ms epoch therefore, the current investigation failed to find support for research suggesting that participants high in trait aggression produce reduced P300 amplitudes towards VM (e.g. Barthelow et al, 2006; Engelhardt et al. 2011). Likewise, this research did not provide any evidence to support previous research suggesting that those individuals with a history of VVG or VM preference would be desensitised towards the content and thus produce reduced P300 amplitudes (e.g. Engelhardt et al, 2011). However, the aggressive groups were assigned based on a dichotomous scale derived from known offender and bully scores (Palmer & Thakordas, 2005; Smith & Waterman, 2004). There has been no consensus in the literature regarding classification for high and low scores and interestingly, there has been a range of methodologies employed when using the BPAQ (Buss & Perry, 1992) to separate the trait scores for the purpose of analysis. For example, using the 25th and 75th percentiles (e.g. Barthelow, 2006) or using the data median as the cut-off point (e.g. Engelhart, Barthelow and Saults, 2011). These unstandardized methods of analysis will have impacted on allocation of participants to conditions for analysis therefore, this requires further investigation and consideration.

Despite the fact that the BPAQ (Buss & Pery, 1992) has been repeatedly found to have high reliability (e.g. Felsten & Hill, 1998; Gerevich et al., 2007; Pechorro, Barroso, Poiares, Oliveira, & Torrealday, 2016), Harris (1997) suggested that social desirability (Marlowe & Crowne, 1961) could influence participant response (Anguiano-Carrasco et al., 2013; Vigil-Colet et al., 2012). This was based on results that showed a moderate negative correlation with the BPAQ aggression scales (Harris, 1997). Thus, this may be considered a limitation of the current research and could have had an impacted on true trait aggression scores.

Despite the plethora of research suggesting that previous experience of VVG increased activation towards violent images (e.g. Bushman and Anderson, 2002; Carnegy, Anderson and Bushman, 2007; Engelhardt et al. 2011; Uhlman and Swanson, 2004), the results of the current research demonstrated that this was not the case and furthermore, failed to find any significant differences between those who had previous experience of, and preference towards, VVG in comparison to those who had little to no experience or preferred NVVG, regardless of epoch or region. However, preference towards violent in comparison to non-violent films was shown to have an effect on ERP response towards violent content imagery. Participants in the non-violent group responded with a significantly increased negative response at frontal and temporal measurement sites across the 100, 200 and 300ms epochs in comparison to those in the violent film preference group.

Godleski et al. (2010) stated that an enhanced ERP amplitude was demonstrative of increased cognitive load and motivated attention. Thus, the results of the current research could suggest that preference toward violent films motivated attention and drew interest towards violent content instead of increasing aggressive cognition and behaviours as has been previously suggested (e.g. Anderson and Bushman, 2001; Engelhardt et al., 2011). Furthermore, consistent with the predictions of the CMoA (Ferguson, Rueda, et al., 2008), current results showed that previous life experience had an effect on activation in response to affective imagery. Participants who had been a witness or victim to a violent crime illustrated significantly increased positive activation across the P300 epoch towards violent images in the temporal sites (T7 & T8) in comparison to the group without previous personal experience of a violent crime. Thus, this could further demonstrate that both preference towards VM and previous personal experience thereof, motivated attention towards salient stimuli which has been associated with memory (Schupp at al., 2004). Based on these findings, it could also be suggested that there was support for cognitive theories of learning (e.g. experience of real or fictional violence changes response towards violent stimuli) such as the SLT (Bandura, 1978) and the GAM (Anderson & Bushman, 2001). However, it must be made clear, the current results and findings are minimal and should not be overstretched in their explanatory power.

The stimuli presented within the violent category were an accumulation of depictions of violence as available and categorised within the IAPS (Lang et al., 2008) inventory. These were for example, a male holding a knife to a female's neck; a young boy holding a large gun across his chest; an enlarged depiction of a gun being held to the screen. The content and context of these could have an effect on ERP response due to the mismatch between content elements over the stimuli set (i.e. face and figures; age of the actor / 'assailant'; whether the image was real or posed; whether the effect was aimed at the participant or another). Several defining factors have been identified as having an effect on response towards stimuli however, the nature of the IAPS images may have impeded the true evoked response towards any one image category.

For example, in the violent category, there may have been sex differences towards the images depicting young children (i.e. response was due to the context of the child rather than the violent nature of the image). Additionally, Ramos, Ferguson, Frailing, and Romero-Ramirez (2013) stated that individuals elicit a stronger response to real in comparison to content that was considered to be faked or posed. Therefore, any images that were perceived as faked or posed (e.g. the young boy holding the weapon across his chest) could have introduced confounding variables into the research. Therefore, further consideration should be taken regarding the IAPS category content and context.

There have been numerous studies where the IAPS images have been used to determine a 'violent' category of stimuli however, upon closer inspection there have been cases where the images used have been of content more closely termed disgust (i.e. mutilations; rotting flesh; injury and infection) (e.g. Engelhardt et al., 2011). Within this research it was ensured that content viewed as disgust were omitted and only stimuli deemed violent were included. This single content category formation could highlight, and go some way to explain, some of the differences found between this investigation and other media research exploring VM effects. The addition of a further image category (Disgust) in future research would allow continued consideration of this point (van Hooff, van Buuringen, El M'rabet, de Gier, & van Zalingen, 2014).

Finally, media research has traditionally discussed ERP amplitude at the Pz site over the 300ms epoch (referring to the P3 or P300) in response to VM. Where graphs of data have been made freely available (e.g. Engelhardt, 2011) it has appeared that peaks of activation have occurred much later than 300ms post stimuli presentation at around 550-600ms. Although this is acknowledged as potentially typical timing, it may suggest an explanation for differences in findings and thus future research should accommodate for the later epoch with an additional measurement (an early, late positive potential: ELPP) taken for a 400 – 600ms timescale.

3.6.3 Erotic Category Content

Overall: On examination of the topoplots, response towards erotic stimuli began very early with a developing negativity in the frontal region, especially for females. However, males developed two areas of negative activation around 200ms post stimuli presentation in both the right and left frontal region. Thereafter, the male response appeared prodominantly positive where females appeared to develop an increasing negative activation across frontal regions with an area resembling a strip of negative activation that began around 400ms post stimuli presentation and appeared to travel down the z line. There were no significant sex differences found in response to the erotic content category and differences were only significant for those who prefered violent, rather than non-violent films, in frontal regions (Fz & Fcz) over the 300ms epoch.

In general, studies focusing on visual sexual stimuli have found that interest and response towards EM has favoured males in comparison to females (e.g. Hamann, Herman, Nolan and Wallen, 2004; Kuhn &

Gallinat, 2014). However, this research found no significant sex differences in response to erotic content. Although the stimuli content were selected from the IAPS inventory based on their sexual composition, it has been suggested that these types of images could be processed as 'romantic' rather than 'sexual' (Spiering, Everaerd, & Laan, 2004) and not a true representation of visual sexual stimuli widely available (i.e. over the internet). Additionally, due to their outdated content, some of the images would be considered fetish related. Thus, this could have had an effect on response across sex that could explain the current results.

Although there was a lack of statistically significant sex differences in response towards erotic content, there was visual evidence of activation differences from viewing the topoplot data (see Figure 35). These visual findings show some support for research suggesting that females and males process EM differently (e.g. Anokhin et al, 2006; Rupp and Wallen, 2007; van Hoof, Crawford and van Vugt, 2010; Whittle et al, 2011). However, females have shown a nonspecificity of sex in interest towards erotic stimuli (Chivers et al., 2007) and thus could possibly go some way to explaining the lack of statistically significant results.

Chivers et al. (2007) found that heterosexual females reported less sexual interest and motivation towards images of nude females than males whereas homosexual females responded more to nude female in comparison to male depictions. Therefore, by providing participants with imagery only of their opposite sex would have led to the provision of an unbalanced set of stimuli. Although this research showed all participants the same selection of erotic images; a method that avoided the confound usually overlooked by displaying erotic images of the opposite sex only (Chivers et al., 2007), due to the female nonspecificity, this may explain the visual differences (yet lack of statistical differences) recorded. Moreover, within the current research, participant sexual orientation was not taken into account (images were balanced for sex however not balanced for sexuality preference) and thus motivated preference and attention (e.g. Boheart, 2001; Nordstrom and Wiens, 2012) could have influenced results. These highlighted points require additional consideration in future research. However, they are currently beyond the scope of this thesis.

In addition, it has been established that there are sex differences in gaze, focus and attention towards differeing elements of visual scenery (e.g. Rupp & Wallen, 2006). For example research using eye tracking methods found that both sexes tended to focus on figures rather than the scenery or faces (Lykins et al., 2008). However, Rupp and Wallen (2006) suggested that hormones could play an important role in focal points after finding that females using oral contraceptives directed their focus on background scenary to a greater extent than male participants. In comparison to females, males focused on both faces and figures of the opposite sex (Rupp & Wallen, 2007, 2008; Wallen & Rupp, 2010).

There were no significant results based on high or low trait aggression scores. Thus, this suggested that aggression did not moderate response towards erotic content. Moreover, that high and low scoring females did not significantly vary in response towards erotic IAPS images. Further research would be required to establish if there were any differences in response between high and low scoring males.

3.6.4 Neutral Category Content

Overall: The topoplot data showed that all participants demonstrated early negativity in frontal regions that developed into positive activation across the cortices (this was more reserved over central regions) at approximately 300ms post stimuli presentation. However, the female response was slightly earlier and more pronounced than that of the male response. In addition, females developed negative activation at around 400ms post stimuli presentation in frontal and left frontal regions in comparison to males.

Several differences were found for neutral image content (i.e. differences moderated by sex, trait aggression scores, preference towards playing VVG's and preferences towards watching violent films). Thus, this potentially highlighted an issue with the IAPS image content as findings showing significant differences in response between samples as has clearly been shown, demonstrated a variance in the general public that exceeds the expected (e.g. Field, 2014).

This could be explained by the variety of elements and content across the IAPS image category. For example, human attention and response has been linked with the presence of a face (Leopold & Rhodes, 2010; Luo et al., 2010). Even in the presence of a distractor, face-evoked p300s have shown prioritised processing and resistance to distraction (Marhofer, Bach, & Heinrich, 2014). Yet within the IAPS neutral category there is an unstipulated number of images that show faces (human and animal) and figures. Thus, this research has raised a question regarding the introduction of confounding variability within stimuli that has faces and figures present, especially when presented in an unbalanced configuration.

These results have questioned the neutrality of the neutral images from the IAPS and thus questioned the ability to use the IAPS neutral images as a baseline measure. Previous research using affective media in comparison to neutral content (e.g. Codispoti, Ferrari and Bradley, 2007; Coyne et al., 2008) may have overlooked the highlighted variability in response, potentially contaminating the data and manipulating the significance of the results. Thus, subsequent research using the IAPS imagery should be aware of this and ensure that it is accommodated for within the adopted methodological design.

3.6.5 Summary

This research has established, by no means exhaustively, that many alternative factors such as sex, previous experience of violent crime and individual preference towards certain types of violent media had an effect on neurological activation in response to affective images. There was no current evidence to support the GAM (Anderson and Bushman, 2002) or the IEM (Malamuth and Briere, 1986) however, some support was found for the CmoA (Ferguson, Rueda, et al, 2007) as it appears that there are effects of alternative variables that have not been fully investigated. Furthermore, there was no support for the desensitisation effect in relation to VM (e.g. Engelhardt et al., 2011) based on previous preference towards VM, or high aggression score, in relation to violent imagery. However, this research clearly supported the need to include sex as an independent variable and identified several future refinements to the current methodology (i.e. inclusion of an early LPP; inclusion of a central measurement cluster; tighter participant inclusion criteria to meet the restrictive cultural and sexual preference content of the IAPS images).

This pilot scale research has identified that future investigations should aim to significantly increase the sample size as this would allow recruitment of sufficient participants per data cell to be able to conduct a full analysis across variables (i.e. include all levels of the independent variable) (Field, 2013; Howell, 2013). It could also illuminate the relevance of current results that were approaching significance and further to determine the differences that are visually present (e.g. topoplots and ERP graphs) but are statistically non-significant. However, based on the results provided, this research has suggested that the link between VM, EM and aggression is still speculative and requires extensive further research.

3.7 Key Findings

There was insufficient evidence to support or refute the predictions of The General Aggression Model (Anderson & Bushman, 2002) and the Indirect Effects Model (Malamuth, 1986). However, there was some support for the Catalyst Model of Aggression (Ferguson, 2007).

The results supported several key findings from previous literature for example; the early female negativity bias (Lithari et al., 2009); sex differences in visual stimuli processing (e.g. Lusk, Carr, Ranson, & Felmingham, 2017; Lykins, Meana, & Strauss, 2008; Ruigrok et al., 2014; Rupp & Wallen, 2008; Victor, Drevets, Misaki, Bodurka, & Savitz, 2017) and highlighted important avenues for further research.

There were significant differences in emotional processing due to violent media.

There were significant sex differences found in response to the image categories.

There was no evidence to support the desensitisation effect in response to violent visual stimuli.

There were significant differences found moderated by alternative factors (e.g. sex, previous life experiences and lifestyle choices) as specified in the literature.

Chapter 4 **"Don't Look Now – It's a Gory, Violent Bit!"**

The Gruesome, Hot Under the Collar Effects of the Media: ERP's in Response to Violent, Disgusting, Erotic and Neutral Imagery

4.1 Abstract

The rapid processing and evaluation of the visual environment has been critical to the longevity of the human race (Duntley & Shackelford, 2008; Sala et al., 2015). However, concern has been highlighted regarding the modifying effect on the brain and behaviour from the processing and evaluation of real and fictional depictions within digital media (e.g. Anderson and Bushman, 2002). Based on the findings from the previous study (Ch 3.), there was reasoning and justification to conduct a further investigation that aimed to provide a baseline within the media research field using EEG research methodology. This study refined aspects of the previous methodology. However, due to the clear findings of the previous research, it was hypothesised that there would be differences in event related potential (ERP) response based on participant sex, preference towards certain types of violent media and personal experience of violent crimes. Participants (n = 78) completed questionnaires (the Buss and Perry Aggression Questionnaire and a demographic questionnaire) prior to passively viewing images from four categories (Violent; Erotic; Disgust and Neutral) over 1000ms. The images were provided by the International Affective Picturing System (Lang et al., 1997, 2008). Consistent with previous research, results indicated that factors such as sex, previous experience of violent crime and individual preferences towards violent media had a significant effect on ERP amplitude in response to affective images. However, within-sex differences did not replicate all findings and questioned the reliability of some dichotomous variables. This research has offered a basic explanation for the desensitisation effect towards VM (Bartholow et al, 2006; Engelhardt et al, 2011) and has suggested that further research and refinement is required into stimuli content prior to the proposal of further theorised media effects. This research has supported the previous findings (Ch.3); the female negativity bias (e.g. Lithari et al, 2010); research and theory providing that attention is motivated towards evolutionary salient stimuli (e.g. Gur et al, 2002; Kim et al. 2013; Schupp, Junghofer, Weike and Hamm, 2003; Weinberg and Hajak, 2010; Wheaton et al, 2013), and preferred media content (Boheart, 2001; Nordstrom and Wiens, 2012).

4.2 Introduction

The rapid processing and evaluation of the visual environment has been critical to the longevity of the human race (Duntley & Shackelford, 2008; Sala et al., 2015). However, concern has been highlighted regarding the modifying effect on the brain and behaviour from the processing and evaluation of real, and fictional, depictions within digital media (Anderson & Bushman, 2001; Engelhardt, Bartholow, Kerr, et al., 2011; Engelhardt, Bartholow, & Saults, 2011; Groves & Anderson, 2015b; Groves et al., 2016). The preceding research (see Ch 3.) supported the Catalyst Model of Aggression (Ferguson, 2007), research suggesting that there is an early female negative bias (Lithari et al, 2010) towards affective imagery and research and theory providing that attention is motivated towards evolutionary salient stimuli (e.g. Gur et al, 2002; Kim et al. 2013; Schupp, Junghofer, Weike and Hamm, 2003; Weinberg and Hajak, 2010; Wheaton et al, 2013), and preferred media content (Boheart, 2001; Nordstrom and Wiens, 2012). However, there was inadequate evidence to support or refute the predictions of the GAM (Anderson and Bushman, 2002) or the desensitisation effect (Engelhardt et al., 2011). Moreover, due to recruitment issues, there was insufficient participants to quantify a thorough analysis of aggression categories.

Thus, based on those results (Ch 3.), it was concluded that there was evidence to justify a larger scale investigation with an increased sample size. Additionally, it was outlined (see Ch 3.) that the current advancement should include methodological modifications (i.e. the addition of an epoch 'ELPP'; the addition of disgust stimuli category) in order to determine the relevance of previous results; illuminate any findings that were approaching statistical significance or visually present via the topoplot representations (see Figure 35 for summary and Appendix AE for full details.) and to provide results that would act as a baseline, and platform, for the development of future research. However, the discussion and analysis of trait aggression has been removed from this chapter and placed for detailed analysis separately (see Ch 5.).

Previous results have demonstrated that there were clear sex differences in mean ERP response toward affective imagery across all epochs (see Ch. 3.). Females tended to respond with a negative bias in comparison to males (Lithari et al., 2010) across image categories. Additionally, females tended to respond with an increased mean ERP amplitude in comparison to males. This supported research that had shown neurological sex differences in response towards stimuli (e.g. Filkowski, Olsen, Duda, Wanger, & Sabatinelli, 2017; McGlade, Rogowska, & Yurgelun-Todd, 2015; Lithari et al., 2011) especially where the stimuli appeared emotive or danger focused (Han et al., 2008; Kempton et al., 2009; Kim et al., 2013; Whittle et al., 2011). These findings supported the continued need to include sex as an important factor in considering the media effect on neurological response and behaviour (Filkowski et al., 2017). Moreover, it highlighted the necessity to provide a more detailed analysis of the results that would include a within sex effect across alternative variables (i.e. preference towards VM types and previous experience of violent crimes) as previous findings that appeared to be moderated by alternative factors (e.g. preference towards VM) may have been explained by sex differences due to sampling.

Barthelow (2006) stated that exposure to VM evokes avoidance – related motivational states such as fear or disgust and Engelhardt (2011) suggested that exposure to these types of media created a desensitisation effect that could be clearly measured via a reduced P300 component for those with previous experience of VVG use. Taken together, these effects would lead to 'stable increases in aggression' (Barthelow, 2006, p.53). However, as previously suggested, where the stimuli sets have been disclosed (e.g. Barthelow, 2006) images presented as violent, have been combined with content that would more appropriately categorized as disgust (both moral and core). This meant that the previous research (i.e. Ch 3.) had potentially missed the desensitisation effect due to the lack of disgust stimuli and that research based on mixed content stimuli (i.e. violent and disgust) could have confounded the results.

Although it has been well documented that emotionally salient stimuli (e.g. VM, EM or disgusting media (DM)) are preferentially processed and demand more attentional resources than neutral stimuli (e.g. Van hoof et al., 2014), there has been notable differences in response between the groups of category content (e.g. Carretié, Ruiz-Padial, López-Martín, & Albert, 2011). For example, ERP modulations have been repeatedly identified as a function of motivation, interest and emotive significance (Schienle, Schäfer, & Naumann, 2008; Schienle et al., 2005; Schupp et al., 2000; Schupp, Cuthbert, et al., 2004; Schupp et al., 2003; Schupp, Junghofer, et al., 2004; Whittle et al., 2011) with increased P300 and LPP being found in relation to unpleasant images in comparison to pleasant (e.g. Cuthbert et al., 2000; Weinberg & Hacjack, 2010). Using pleasant (e.g. erotic), unpleasant (e.g. mutilations) and neutral (e.g. household items) images, Cuthbert et al. (2000) found that pleasant images were associated with the most increased electrocortical activation and skin conductance measurements followed by unpleasant content and neutral content. Similarly, enhanced P300 and LPP activation have been found in response to fear and disgust images for phobic individuals (Leutgeb, Scha¨ fer, & Schienle, 2009; Schienle et al., 2008). Schienle et al., (2008) found that control participants showed increased P300 and LPP amplitudes in comparison to neutral images whereas phobic participants showed significantly increased responses towards images related to their phobia but not towards other categories. However, this sample consisted of female participants only and therefore male comparison cannot be made. Nevertheless, Weinberg and Hajcak (2010) supported these findings and demonstrated that unpleasant images produced an increased LPP in comparison to pleasant images but EM, VM and images of mutilation showed similar LPP responses from an opportunity sample. Thus, this suggested that directed attention towards fear and disgust related content evoke ERP differences. However, there have been very little research directly investigating the differences in evoked ERP between violent and disgust stimuli. This is in part due to the general trend to provide participants with stimuli based on valence and arousal only rather than content and context (Anokhin et al., 2006).

Nonetheless, it has been suggested that differences in response to stimuli categories could be associated with the difference in processing toward differing content and subjective context (Anokhin et al., 2006; van Hooff et al., 2014). For example, violent (i.e. a knife held to the face) and core disgust (i.e. a rotting corpse of an animal) stimuli would likely require different directed behaviour (van Hooff, Devue, Vieweg, & Theeuwes, 2013; van Hooff et al., 2014) and/or cost/benefit analyses in real life situations (Carretie, Hinojosa, Martin-Loeches, Mercado, & Tapia, 2004; Carretie et al., 2011) as the effect of a knife being held to ones throat in comparison to the sight of rotten flesh would require different processing and evaluation. Therefore, the disgust category may have warranted additional attentional resources (Caseras et al., 2007) and had evoked a processing pattern that was confounded by the unspecified mix of violent and disgust stimuli within previous media research (e.g. Bartholow et al., 2006; Engelhardt et al. 2011). Therefore, based on the above and the fact that content related to disgust (i.e. mutilation, carcass, flesh, immoral sexual and non-sexual depictions) can be prevalent in digital entertainment media, this category was added as a separate content category within the current research.

Disgust content has been implicated in moral judgements (Carretie et al., 2011; Olatunji, Puncochar, & Cox, 2016) and has been shown to effect the severity of moral decisions (Wheatley & Haidt, 2005; Yoder & Decety, 2014). This is particularly interesting when understood in relation to the potential negative media effects on the brain and behaviour (e.g. Anderson & Bushman, 2001; Bartholow et al, 2006; Engelhardt et al, 2011; Huesmann, 2010; Malamuth, 1986; Malamuth, Addison, & Koss, 2000; Malamuth, Hald, & Koss, 2012). Where EEG methodology has been used to investigate media effects (e.g. Bartholow et al, 2006; Engelhardt et al, 2011) and participants have been introduced to a confounded stimuli content, results have shown a significantly reduced P300 activation in the parietal region for those exposed to VM.

Disgust stimuli has induced early processing differences and attention bias in comparison to fear images (van Hooff et al., 2013; van Hooff et al., 2014) and it has been suggested that core disgust evoked the largest N100 and P200 amplitudes in comparison to moral disgust and neutral stimuli. Whereas, stimuli viewed as moral disgust evoked larger N200 amplitudes in comparison to neutral and core disgust stimuli (Zhang et al., 2015). Additionally, core disgust content has tended to elicit an increased P300 and LPP in comparison to moral disgust content (Zhang et al., 2015) thus suggesting that neurological activation could be modified based on subcategory content. However, neuroimaging studies have shown that both core and moral disgust stimuli tend to activate similar neural locations (Moll, De Oliveira-Souza, & Zahn, 2008; Parkinson et al., 2011). For example, substrates including the basal ganglia, amygdala, thalamus, parahippocampal gyrus, and dorsal anterior cingulate were shown to be activated by both moral and core disgust (Borg, Lieberman, & Kiehl, 2008) with a stronger association of the temporal poles and medial prefrontal cortex for moral disgust and core disgust activating the left amygdala and frontal lobe regions (Borg et al., 2008). Thus, using images available from the IAPS (Lang et al., 1997, 2008) and based on those images known to have been interspersed with the violent category previously, there was an equal selection of both core and moral disgust depictions employed.

Due to the restrictive, non-inclusive nature of the IAPS image catalogue, the former research suggested that findings toward stimuli content may have been affected due to confounding factors. For example, but not limited to, the inability to represent cross cultural and sexual preference differences within the image categories required the inclusion criteria of participants to be modified to reflect this (Balas et al., 2011; Eberhardt et al., 2004; Rupp & Wallen, 2007, 2008; van Hooff et al., 2011). Sexual preference has been shown to modulate response towards visual sexual stimuli (Waismann, Fenwick, Wilson, Hewett, & Lumsden, 2003) and evidence of an own-race bias in the neural signature has been reported (Wiese et al., 2014). Thus, participant inclusion criteria in the following upscaled research was refined to necessitate participants to self-identify as heterosexual and white, British.

4.3 Key Aims & Hypothesis

To conduct a large-scale study investigating potential differences in emotional processing due to exposure to violent media employing a methodology that included essential procedures that have been outlined in the literature by EEG methodologists.

Investigate differences between published research data that has had the methodology negatively critiqued and the results from this pilot study, to provide a baseline for further studies.

Investigate potential differences in emotional processing due to alternative factors (e.g. sex, previous life experiences and lifestyle choices) when viewing affective imagery.

Hypothesis 1. There will be sex differences in response to affective imagery

Hypothesis 2. There will be differences in mean ERP response towards affective imagery based on preference towards violent and nonviolent media.

Hypothesis 3. There will be differences in neurological response towards affective imagery based on previous exposure to a violent crime.

4.4 Key Refinements from Chapter 3.

To update the stimuli categories (images) to include an additional “disgust” category.

To update epochs to include an early and late LPP (ELPP & LLPP).

To update participant criteria to remove potential confounding variables of race or sexual orientation e.g. participants should self-identify as white, British, heterosexual.

4.5 Methodology

The methodology used throughout this research has been outlined within the methodology chapter (see Ch 2.). Only chapter specific details have been provided below.

4.5.1 Participants

An opportunity-based sample of 78 healthy right-handed volunteers (Male N= 35; female N= 43) were recruited to take part in this research. There was a broad age range (females mean= 22.53, SD= 5.82, range 18-38; males mean= 21.57, SD= 4.94, range 18-39). The sample were not paid for their participation, however, first and second year psychology students were awarded research credits for participating. All of the participants had normal or corrected to normal vision, 20/20 (UK). Participants with a history of mental health illness and those currently taking un/prescribed medication were excluded from the study.

4.5.2 Apparatus and Materials

The apparatus used was as outlined in the methodology chapter (see ch 2.).

4.5.3 Design

This research was quasi-experimental in design. All variables (except from image) were based on group differences (not random allocation). The research used both repeated and independent measures. The research used both repeated and independent measures. The repeated measures elements were four, subcategories of affective imagery taken from the International Affective Picturing System (Lang et al., 1997, 2008). The categories were Neutral, Violent, Disgust and Erotic (Bartholow et al., 2006; Engelhardt, Bartholow, Kerr, et al., 2011) The independent group's factor measured demographic information such as sex, past experiences (e.g. whether they had been a previous witness or victim to a violent crime) and personal lifestyle preferences (e.g. whether they preferred violent or nonviolent media (films and videogames)). Trait aggression was also measured using the BPAQ (Buss & Perry, 1992). However, all trait aggression related aspects of this research have been discussed in chapter 5.

Although, the variables were not directly manipulated, they have been referred to as independent variables throughout. The Independent variables (IV) were all alternative factors that have been taken from the literature (e.g. Ferguson et al., 2008; Lithari et al., 2011) and have been discussed in chapter 1. These were sex (2 levels, males and females), previous life experience (Film preference (2 levels, violent and nonviolent), previous experience of violent crime (2 levels, yes and no), videogame preference (2 levels, violent and nonviolent), trait aggression scores (2 levels, High / Low), and image category (3 levels, neutral, violent and erotic). The dependant variable was the grand mean average ERP (measured in microvolt's, μV) scores. However, all reference to trait aggression analysis has been extracted and placed in chapter 5.

4.5.4 Procedure

The experimental procedure was as outlined in the methodology chapter (see Ch 2.2).

4.5.5 Data Analysis

The data was processed and analysed as outlined in Chapter 2.

4.6 Results

EEG amplitudes were recorded, standard descriptive statistics have been summarised below across the sequence of tables. Results have been subdivided into sections below for clarity. Within each of the following subsections, analysis of image type has been embedded.

When the sample size was less than 30 and Central limit theorem does not apply, distribution was checked using the Shapiro Wilks test. Where they were found to be non-normal, they were examined for outliers. Where SPSS boxplots identified extreme values, these were removed. Consequent distributions were more normal. ANOVA is quite a robust test to mild violations of these assumptions (Field, 2010). Therefore, on this basis, analysis commenced. Throughout repeated measures analyses of two or more conditions, if any variables were found to violate the assumption of sphericity using Mauchly's Test of Sphericity, the results were corrected using the Greenhouse-Geisser epsilon correction (Field, 2010). Where applicable, the values presented in the below sets of analyses are the corrected statistics (Field, 2010).

For ANOVA results, one assumption that must be met is that comparison groups (independent groups) should have similar dispersion of scores (homogeneity of variance) at all levels of the between-subject variables (Field, 2010). The Levene's Statistic was used as a measure of this. However, generally this would only be a problem with small samples of different sizes and severe violations (Field, 2010). As ANOVA has been viewed as a robust test (Field, 2010), only severe violations with small samples of different sizes were further investigated. Alpha was set at 0.05 throughout. Appropriate post hoc tests were run. For where there were two independent groups, independent t-tests were used and where there were dependent groups, paired samples t-tests were run. For any of these dichotomous variable's alpha was adjusted to 0.025 to take account for inflated type 1 error. For three or more groups, Bonferroni test was used. Cohen's D was used to as an appropriate measure of effect size for any comparisons between two means. As SPSS does not calculate this, Cohen's *d* effect sizes were manually calculated. This type of effect size is based on the mean differences between samples dived by the standard deviation (Field, 2010). Where the standard deviation of groups was unequal, a pooled standard deviation was calculated and used as the denominator.

The data was segmented into epochs (100ms, 200ms, 300ms and 400-800ms) (see Ch 2.). Five main cortical measurement sites were selected to reduce the potential number of statistical tests (see Ch 2); the frontal region (Fz), frontal central (Fcz), parietal (Pz) and temporal lobes (T7 – left hemisphere and T8 – right hemisphere) as demonstrated in Figure 10.

4.6.1 Section 1: Sex x Image

This is the analysis of sex differences by location and epoch in response to affective images. Means and standard deviations have been provided in the below sequence of tables (see Tables 26 – 40.). The data was analysed using mixed ANOVA (Sex, 2 levels: Male and Female x Image, 4 levels: Neutral, Violent, Disgust and Erotic). Bonferroni adjusted post-hoc tests for more than two comparisons (e.g. image) and independent t-test (with alpha adjusted to .025) for sex were conducted. Only significant results have been provided below.

4.6.1.1 50 – 150ms Post Stimuli (100ms)

Table 26. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 100ms timeframe.

100ms	Male (n=35)		Female (n=43)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-0.23	2.10	-1.30	1.97
Violent	-1.23	1.53	-1.55	1.75
Erotic	-1.41	2.30	-0.93	2.51
Disgust	-0.44	1.41	-1.43	1.83
Fcz				
Neutral	-0.79	1.56	-1.53	1.72
Violent	-1.41	1.41	-1.68	1.54
Erotic	-1.54	2.03	-1.17	1.93
Disgust	-0.93	1.34	-1.66	1.63
Cz				
Neutral	-1.82	1.37	-0.76	1.23
Violent	-1.68	1.44	-0.98	1.37
Erotic	-1.56	1.12	-0.79	1.10
Disgust	-1.23	1.37	-1.11	1.10
Pz				
Neutral	-0.63	2.53	0.73	1.86
Violent	-0.60	2.34	0.74	1.48
Erotic	-0.25	1.51	0.69	2.23
Disgust	0.33	2.68	0.59	1.88

4.6.1.2 150 – 250ms Post Stimuli (200ms)

Table 27. Means and standard deviations of EEG amplitudes, measured in

microvolt's (uV), for males and females across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 200ms timeframe

200ms	Male (n=35)		Female (n=43)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-1.80	3.18	-3.47	3.40
Violent	-1.33	3.84	-2.16	3.33
Erotic	1.15	4.04	0.77	4.31
Disgust	-1.07	3.71	-2.66	2.91
Fcz				
Neutral	-2.23	2.75	-3.26	2.91
Violent	-1.79	3.73	-2.62	2.63
Erotic	0.62	3.73	0.02	3.34
Disgust	-1.42	3.52	-2.68	2.66
Cz				
Neutral	-1.82	2.92	-0.04	1.95
Violent	-2.57	3.74	-0.52	2.09
Erotic	-0.01	3.00	0.07	1.84
Disgust	-1.11	3.43	-0.45	1.50
Pz				
Neutral	1.07	2.65	3.40	3.15
Violent	-0.40	2.72	2.87	2.89
Erotic	0.25	2.51	1.82	2.60
Disgust	0.84	3.30	2.53	2.94

4.6.1.3 250 – 450ms Post Stimuli (300ms)

Table 28. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 300ms timeframe.

300ms	Male (n=35)		Female (n=43)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-1.50	3.09	-2.13	3.56
Violent	-0.71	5.18	-0.39	4.17
Erotic	0.84	3.75	0.39	5.58
Disgust	-1.33	2.87	-2.07	4.03
Fcz				
Neutral	-2.31	2.81	-2.74	2.95
Violent	-1.54	5.05	-1.63	3.31
Erotic	-0.04	3.18	-0.66	4.42
Disgust	-1.86	2.78	-2.73	3.45
Cz				
Neutral	-2.29	3.23	-1.48	1.94
Violent	-2.68	4.00	-0.69	2.64
Erotic	-0.47	2.93	-0.33	2.39
Disgust	-1.61	3.18	-0.86	2.20
Pz				
Neutral	0.95	2.76	2.14	2.53
Violent	0.76	3.34	3.39	3.14
Erotic	2.41	3.27	3.04	3.22
Disgust	2.51	3.89	3.42	3.09

4.6.1.4 450 - 650ms Post Stimuli (ELPP)

Table 29. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females across Fz, Fcz, Cz and Pz, measurement sites for each image category for the ELPP timeframe

ELPP	Male (n=35)	Female (n=43)

Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-0.83	3.08	-0.99	3.41
Violent	-1.24	4.41	0.20	3.64
Erotic	-2.76	5.32	-1.69	6.80
Disgust	-2.57	4.07	-1.95	4.31
Fcz				
Neutral	-1.56	2.79	-1.51	2.76
Violent	-1.72	4.28	-0.70	2.85
Erotic	-2.79	4.77	-1.71	5.29
Disgust	-2.58	3.65	-2.04	3.47
Cz				
Neutral	-0.82	2.76	-0.35	1.52
Violent	-1.03	3.04	0.62	2.85
Erotic	-0.05	2.83	1.15	2.72
Disgust	-0.60	2.53	0.90	2.50
Pz				
Neutral	1.68	2.74	1.95	2.22
Violent	2.56	2.91	3.18	3.14
Erotic	4.35	3.02	3.62	3.62
Disgust	3.53	3.68	3.91	2.63

4.6.1.5 650 – 850ms Post Stimuli (LLPP)

Table 30. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females across Fz, Fcz, Cz and Pz, measurement sites for each image category for the LLPP timeframe.

LLPP	Male (n=35)		Female (n=43)	

Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-0.25	3.12	-0.36	2.75
Violent	-0.96	3.40	0.56	3.06
Erotic	-1.73	3.71	-1.59	6.37
Disgust	-1.92	3.30	-1.61	3.93
Fcz				
Neutral	-0.70	2.67	-0.64	2.28
Violent	-1.05	3.15	-0.12	2.35
Erotic	-1.66	3.21	-1.40	5.22
Disgust	-1.80	2.93	-1.65	2.95
Cz				
Neutral	0.01	2.06	0.08	1.20
Violent	-0.25	2.24	0.85	2.71
Erotic	0.42	1.99	0.91	2.42
Disgust	0.28	1.80	1.06	2.09
Pz				
Neutral	1.39	2.67	1.35	1.59
Violent	1.87	2.31	2.43	3.01
Erotic	2.84	2.15	2.19	2.88
Disgust	2.48	3.03	3.14	2.38

A visual representation of these results has been provided using ERP waveforms below (see Figure 36 – 67).

Males   Females

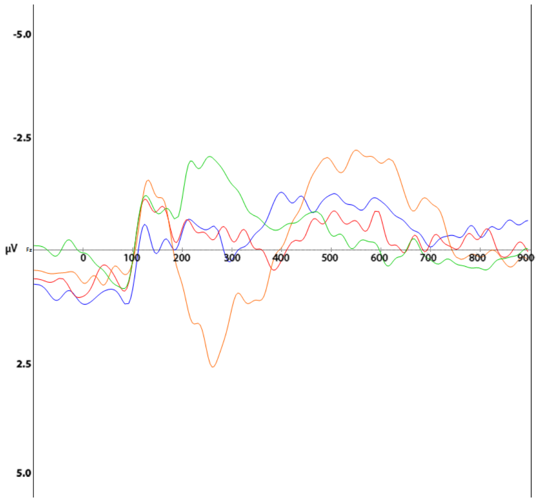


Figure 36. Grand average ERP waveform (microvolts) for males at the Fz location, across time (milliseconds).

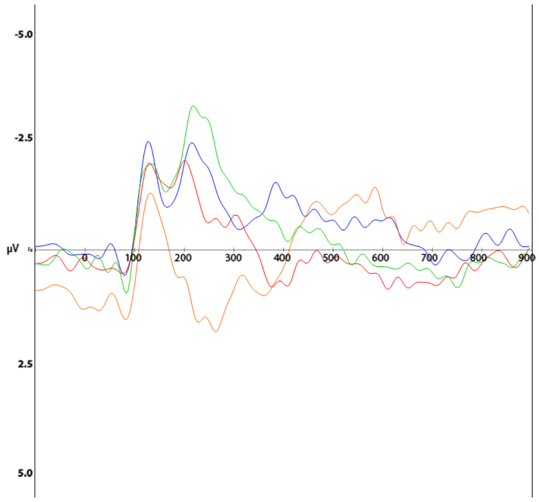


Figure 37. Grand average ERP waveform (microvolts) for females at the Fz location, across time (milliseconds).

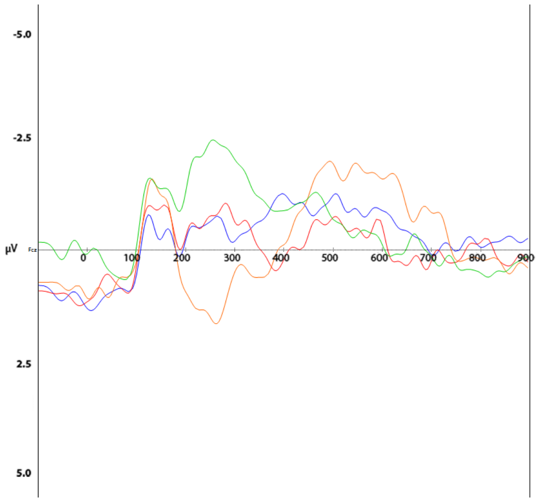


Figure 38 . Grand average ERP waveform (microvolts) for males at the Fcz location, across time (milliseconds).

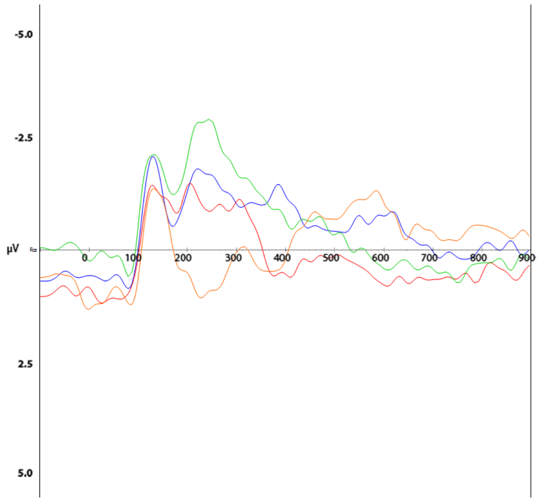
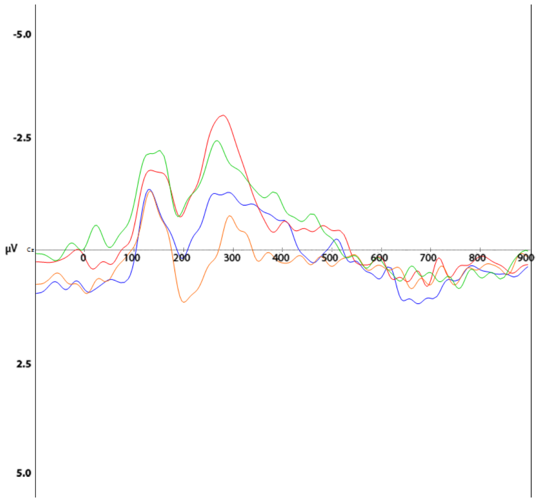


Figure 39. Grand average ERP waveform (microvolts) for females at the Fcz location, across time (milliseconds).



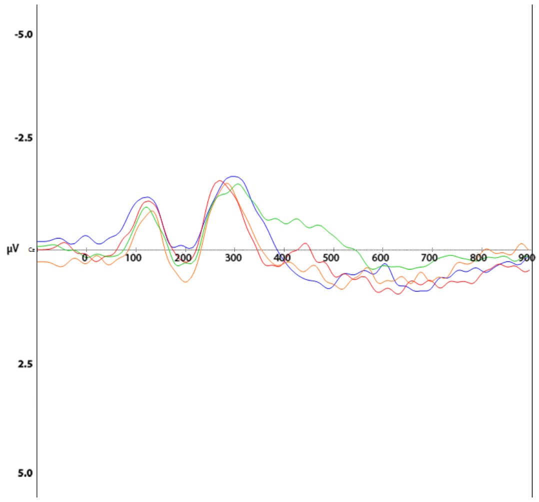


Figure 40. Grand average ERP waveform (microvolts) for males at the Cz location, across time (milliseconds).

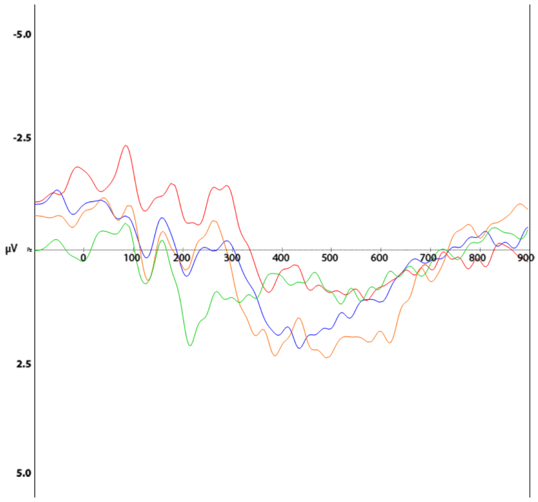


Figure 42. Grand average ERP waveform (microvolts) for males at the Pz location, across time (milliseconds).

Figure 41. Grand average ERP waveform (microvolts) for females at the Cz location, across time (milliseconds).

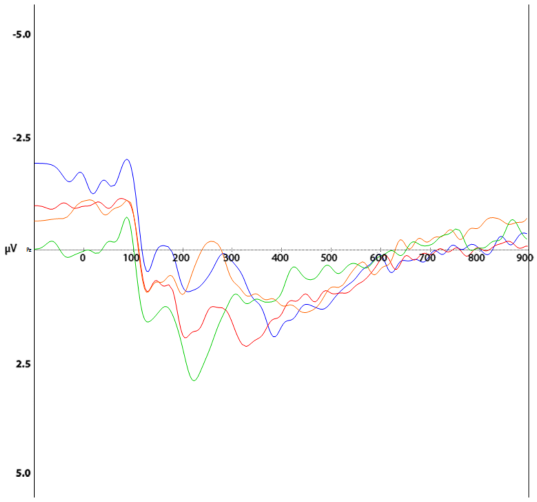


Figure 43. Grand average ERP waveform (microvolts) for females at the Pz location, across time (milliseconds).

Table 31. Significant main and interaction effects across electrode and epoch on grand mean ERP amplitudes in response towards the four image categories.

Site	Epoch	Effect		
		Sex	Image	Interactions
Fz	100ms	$F(1, 76)= 4.86$, $p=0.02$, $\eta p2=.07$	$F(3, 76)= 2.91$, $p=0.04$, $\eta p2=.04$	Sex x Image $F(3, 76)= 4.97$, $p<0.001$, $\eta p2=.06$
	200ms		$F(3, 76)= 15.75$, $p<0.001$, $\eta p2=.17$	
	300ms		$F(3, 76)= 13.07$, $p<0.001$, $\eta p2=.15$	
	ELPP		$F(3, 76)= 6.27$, $p<0.001$, $\eta p2=.08$	
	LLPP		$F(3, 76)= 5.84$, $p<0.001$, $\eta p2=.07$	
Fcz	100ms			Sex x Image $F(3, 76)= 3.65$, $p=0.02$, $\eta p2=.05$
	200ms		$F(3, 76)= 22.46$, $p<0.001$, $\eta p2=.23$	
	300ms		$F(3, 76)= 13.07$, $p<0.001$, $\eta p2=.15$	
	ELPP		$F(3, 76)= 3.53$, $p=0.01$, $\eta p2=.04$	

	LLPP		F(3, 76)= 5.62, p<0.001, ηp2=.07	
Cz	100ms	F(1, 76)= 8.81, p<0.001, ηp2=.10		Sex x Image F(3, 76)= 3.65, p=0.02, ηp2=.04
	200ms	F(1, 76)= 8.81, p<0.001, ηp2=.10		Sex x Image F(3, 76)= 8.05, p<0.001, ηp2=.10
	300ms		F(3, 76)= 13.45, p=0.02, ηp2=.06	Sex x Image F(3, 76)= 4.62, p<0.001, ηp2=.06
	ELPP	F(1, 76)=6.45, p<0.01, ηp2=.08	F(3, 76)= 5.48, p<0.001, ηp2=.07	
	LLPP	F(1, 76)=3.76, p=0.05, ηp2=.06		
Pz	100ms	F(1, 76)=7.26, p<0.01, ηp2=.09		
	200ms	F(1, 76)=17.17, p<0.01, ηp2=.19	F(3, 76)= 6.14, p<0.001, ηp2=.08	Sex x Image F(3, 76)= 3.24, p=0.02, ηp2=.04
	300ms	F(1, 76)=5.11, p=0.02, ηp2=.06	F(3, 76)= 7.50, p<0.001, ηp2=.09	

	ELPP		F(3, 76)= 12.87, p<0.001, ηp2=.15	
	LLPP		F(3, 76)= 5.62, p<0.001, ηp2=.07	

Table 32. Significant p-values from independent T-tests for the effect of sex, across site and epoch (adjusted alpha value =0.025).

	Epoch				
Region and Image Category	100	200	300	ELPP	LLPP
Fz					
Violent					
Erotic					
Disgust	t=2.62, df=76, p=0.01, d=0.61				
Neutral	t=2.31, df=76, p=0.02, d=0.53				
Fcz					
Violent					
Erotic					
Disgust					

Neutral					
Cz					
Violent		t=-3.06, df=76, p<0.01, d=0.68		t=-2.46, df=76, p<0.01, d=0.56	
Erotic	t=-3.58, df=76, p<0.01, d=0.67				
Disgust				t=-2.64, df=76, p<0.01, d=0.60	
Neutral	t=-3.56, df=76, p<0.01, d=0.81	t=-3.22, df=76, p<0.01, d=0.72			
Pz					
Violent	t=-3.08, df=76, p<0.01, d=0.68	t=-5.10, df=76, p<0.001, d=1.17	t=-3.58, df=76, p<0.01, d=0.81		
Erotic		t=-2.79, df=76, p<0.01, d=0.61			
Disgust		t=-2.39, df=76, p=0. 02, d=0.55			
Neutral	t=-2.75, df=76, p<0.01, d=0.61	t=-3.47, df=76, p<0.01, d=0.80			

Table 33. Significant P–values for pairwise comparisons across the effect of image across site and epoch.

Site	Epoch	Effect		
		Image	Difference Between Groups	P-value*
Fz	100ms	$F(3, 76)= 2.91$, $p=0.04$, $\eta p2=.04$	Violent - Neutral	=0.02, d=0.31
	200ms	$F(3, 76)= 15.75$, $p<0.001$, $\eta p2=.17$	Violent – Erotic	<0.01, d= 0.90
			Violent – Neutral	=0.02, d=0.37
			Erotic – Disgust	<0.01, d=0.83
			Disgust – Neutral	<0.01, d=0.23
	300ms	$F(3, 76)= 13.07$, $p<0.001$, $\eta p2=.15$	Violent – Neutral	=0.02, d=0.33
			Erotic - Disgust	<0.01, d=0.55
			Erotic – Neutral	<0.01, d=0.59
			Disgust – Neutral	<0.01, d=0.03
	ELPP	$F(3, 76)= 6.27$, $p<0.001$, $\eta p2=.08$	Violent – Disgust	<0.01, d=0.43
			Erotic –Disgust	<0.01, d=0.09
			Erotic – Neutral	<0.01, d=0.25
	LLPP	$F(3, 76)= 5.84$, $p<0.001$, $\eta p2=.07$	Violent – Disgust	<0.01, d=0.47
			Disgust – Neutral	<0.01, d=0.44
Fcz	200ms		Violent – Erotic	<0.01, d=0.76

		F(3, 76)= 22.46, p<0.001, ηp2=.23	Erotic – Disgust	<0.01, d=0.72
			Erotic – Neutral	<0.01, d=0.96
			Disgust - Neutral	<0.01, d=0.23
	300ms	F(3, 76)= 13.07, p<0.001, ηp2=.15	Erotic – Disgust	<0.01, d=0.55
			Erotic – Neutral	<0.01, d=0.63
	ELPP	F(3, 76)= 3.53, p=0.01, ηp2=.04	Violent – Disgust	<0.01, d=0.32
	LLPP	F(3, 76)= 5.62, p<0.001, ηp2=.07	Violent – Disgust	<0.01, d=0.41
			Disgust - Neutral	<0.01, d=0.24
Cz	300ms	F(3, 76)= 13.45, p=0.02, ηp2=.06	Violent – Erotic	<0.01, d=0.39
			Erotic – Disgust	<0.01, d=0.30
			Erotic – Neutral	<0.01, d=0.55
	ELPP	F(3, 76)= 5.48, p<0.001, ηp2=.07	Erotic - Neutral	<0.01, d=0.47
Pz	200ms	F(3, 76)= 6.14, p<0.001, ηp2=.08	Violent – Neutral	=0.01, d=0.30
			Erotic – Neutral	<0.01, d=0.43
	300ms	F(3, 76)= 7.50, p<0.001, ηp2=.09	Violent - Disgust	=0.02, d=0.23
			Erotic - Neutral	<0.01, d=0.38
			Disgust - Neutral	<0.01, d=0.45

	ELPP	F(3, 76)= 12.87, p<0.001, ηp2=.15	Erotic - Violent	<0.01, d=0.33
			Disgust - Neutral	<0.01, d=0.68
	LLPP	F(3, 76)= 5.62, p<0.001, ηp2=.07	Erotic - Neutral	=0.01, d=0.47
			Disgust - Neutral	<0.01, d=0.61

*Values adjusted for multiple comparisons using Bonferroni correction

There were main effects of sex found across all image categories. Sex differences were found in response to images over all sites except from in the Fcz location. There were sex differences recorded across all epochs except from over the LLPP epoch. There were main effects of image found across every site and epoch. Post hoc tests demonstrated that there were significant differences found between all image categories. There was no evidence of differences between violent and neutral image categories at the Pz 300ms, or ELPP, epoch. There were several sex x image interaction effects found across epoch and site. This demonstrated that the effects of image were not consistent across sex.

Males

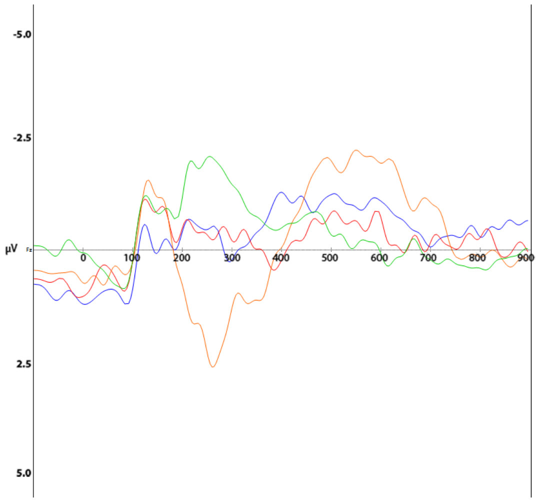


Figure 44. Grand average ERP waveform (microvolts) for males at the Fz location, across time (milliseconds).

Females

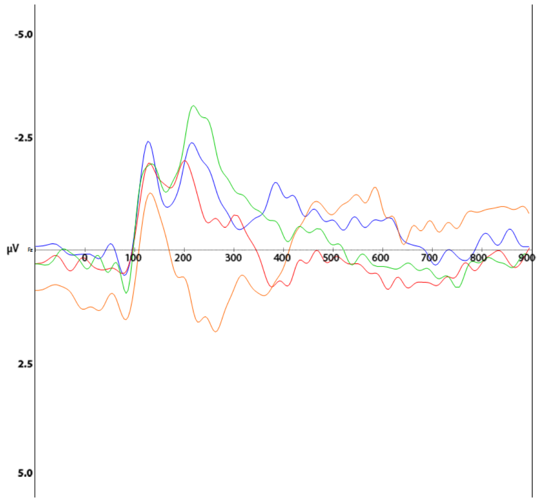


Figure 45. Grand average ERP waveform (microvolts) for females at the Fz location, across time (milliseconds).

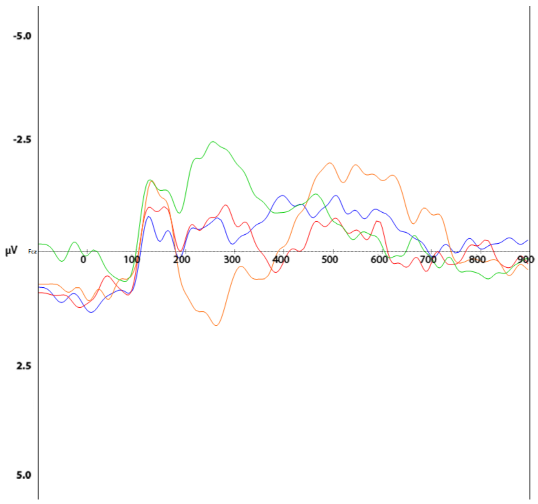


Figure 46 . Grand average ERP

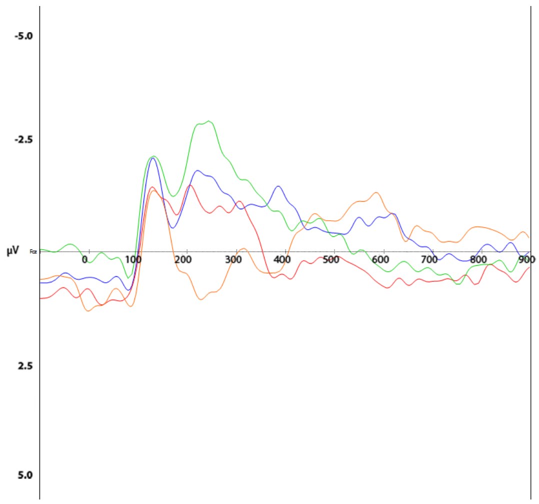
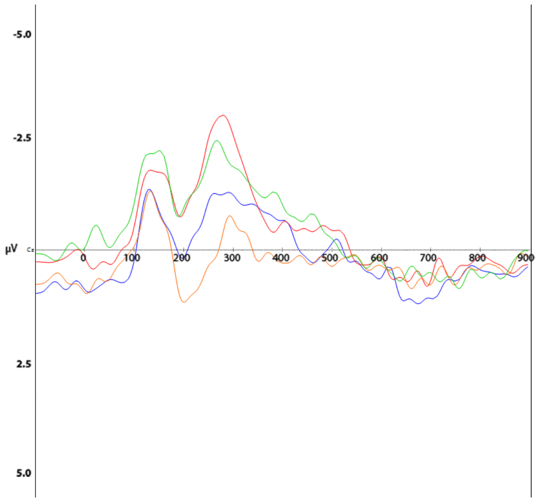


Figure 47. Grand average ERP

waveform (microvolts) for males at the Fcz location, across time (milliseconds).



waveform (microvolts) for females at the Fcz location, across time (milliseconds).

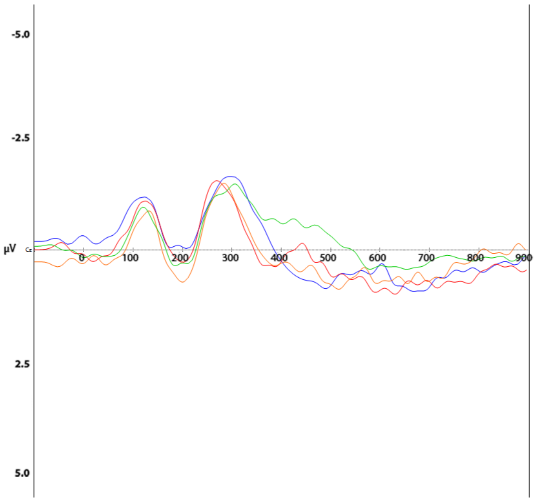


Figure 48. Grand average ERP waveform (microvolts) for males at the Cz location, across time (milliseconds).

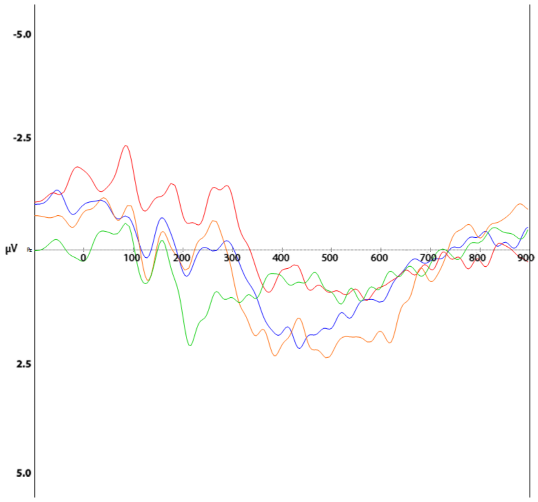


Figure 49. Grand average ERP waveform (microvolts) for females at the Cz location, across time (milliseconds).

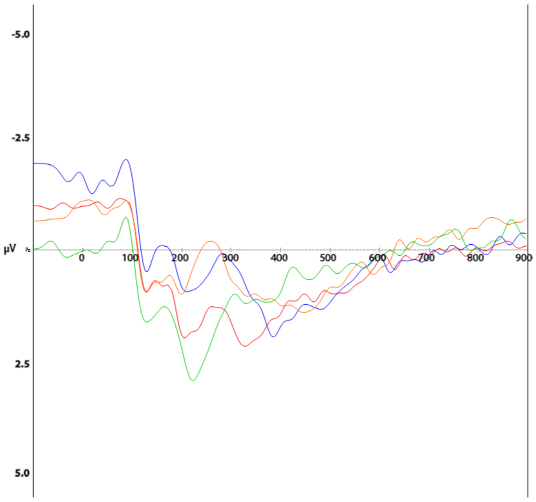


Figure 50. Grand average ERP waveform (microvolts) for males at the Pz location, across time (milliseconds).

Figure 51. Grand average ERP waveform (microvolts) for females at the Pz location, across time (milliseconds).

4.6.2 Section 2: Sex x Witness/Victim to a Violent Crime x Image

This is the analysis of sex differences, whether or not participants had been a witness or victim to a violent crime by location and epoch in response to affective images. Means and standard deviations have been provided in the below sequence of tables (see Tables 34 – 43.). The data was analysed using mixed ANOVA (Sex, 2 levels: Male and Female x Witness to a violent crime, 2 levels; Yes and No x Image, 4 levels:

Neutral, Violent, Disgust and Erotic). Bonferroni adjusted post-hoc tests for more than two comparisons (e.g. image) and independent t-test (with alpha adjusted to .025) for sex were conducted. Only significant results have been provided below.

4.6.2.1 50 – 150ms Post Stimuli (100ms)

Table 34. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who have, and have not been victims or witnesses to a violent crime across all measurement sites for each image category for the 100ms timeframe.

100ms	Yes (n=28)		No (n=50)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-0.85	1.74	-0.80	2.27
Violent	-1.14	1.78	-1.55	1.58
Erotic	-1.13	1.42	-1.15	2.84
Disgust	-0.55	1.36	-1.23	1.85
Fcz				
Neutral	-1.17	1.54	-1.21	1.77
Violent	-1.29	1.72	-1.71	1.32
Erotic	-1.48	1.40	-1.25	2.24
Disgust	-1.09	1.37	-1.46	1.62
Cz				
Neutral	-1.30	1.34	-1.20	1.43
Violent	-1.09	1.64	-1.41	1.31
Erotic	-1.60	1.04	-0.87	1.16
Disgust	-1.33	0.93	-1.08	1.36
Pz				
Neutral	-0.02	1.93	0.20	2.47
Violent	0.15	2.24	0.13	1.90
Erotic	-0.41	1.45	0.65	2.15
Disgust	-0.22	1.80	0.86	2.41

4.6.2.2 150 – 250ms Post Stimuli (200ms)

Table 35. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who have, and have not, been victims or witnesses to a violent crime across the all measurement sites for each image category for the 200ms timeframe.

200ms	Yes (n=28)		No (n=50)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-2.69	2.77	-2.74	3.71
Violent	-1.37	3.41	-2.03	3.67
Erotic	0.50	2.47	1.19	4.87
Disgust	-1.05	2.79	-2.44	3.57
Fcz				
Neutral	-2.82	2.24	-2.79	3.19
Violent	-1.86	3.02	-2.46	3.27
Erotic	-0.20	2.26	0.56	4.04
Disgust	-1.45	2.58	-2.49	3.35
Cz				
Neutral	-0.89	2.12	-0.81	2.81
Violent	-1.00	2.87	-1.68	3.22
Erotic	-0.51	1.67	0.34	2.71
Disgust	-0.67	2.15	-0.78	2.78
Pz				
Neutral	2.22	3.01	2.43	3.24
Violent	1.57	3.68	1.31	3.01
Erotic	0.33	2.30	1.55	2.77
Disgust	1.11	3.39	2.14	3.06

4.6.2.3 250 – 450ms Post Stimuli (300ms)

Table 36. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who have, and have not been victims or witnesses to a violent crime across the all measurement sites for each image category for the 300ms timeframe.

300ms	Yes (n=28)		No (n=50)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-2.13	2.83	-1.68	3.63
Violent	-0.26	4.40	-0.68	4.77
Erotic	-0.51	2.76	1.21	5.59
Disgust	-1.93	2.92	-1.63	3.88
Fcz				
Neutral	-2.89	2.29	-2.36	3.16
Violent	-1.37	4.01	-1.71	4.27
Erotic	-1.33	2.24	0.16	4.52
Disgust	-2.59	2.67	-2.20	3.45
Cz				
Neutral	-2.17	2.51	-1.66	2.67
Violent	-1.44	3.76	-1.66	3.29
Erotic	-1.30	1.93	0.12	2.84
Disgust	-1.72	2.66	-0.90	2.70
Pz				
Neutral	1.28	2.26	1.79	2.91
Violent	2.18	3.87	2.23	3.27
Erotic	1.97	2.36	3.19	3.59
Disgust	2.14	2.93	3.50	3.69

4.6.2.4 450 – 650ms Post Stimuli (ELPP)

Table 37. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who have, and have not, been victims or witnesses to a violent crime across all measurement sites for each image category for the ELPP timeframe

ELPP	Yes (n=28)	No (n=50)

Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-1.38	3.15	-0.66	3.31
Violent	-0.27	3.73	-0.55	4.24
Erotic	-3.58	3.84	-1.38	7.05
Disgust	-2.06	2.81	-2.31	4.82
Fcz				
Neutral	-2.04	2.59	-1.25	2.83
Violent	-0.96	3.21	-1.27	3.79
Erotic	-3.52	3.51	-1.45	5.65
Disgust	-2.36	2.61	-2.24	3.99
Cz				
Neutral	-0.65	2.22	-0.51	2.16
Violent	0.22	3.55	-0.31	2.72
Erotic	-0.56	2.70	1.26	2.68
Disgust	-0.34	2.32	0.54	2.73
Pz				
Neutral	1.99	2.14	1.74	2.64
Violent	3.51	3.57	2.56	2.67
Erotic	2.86	2.16	4.56	3.76
Disgust	2.78	2.43	4.28	3.36

4.6.2.5 650 – 850ms Post Stimuli (LLPP)

Table 38. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who have, and have not been victims or witnesses to a violent crime across all measurement sites for each image category for the LLPP timeframe.

LLPP	Yes (n=28)		No (n=50)	
Region and Image Category	Mean	SD	Mean	SD
Fz				

Neutral	-0.28	2.76	-0.33	3.01
Violent	0.32	3.11	-0.38	3.38
Erotic	-2.74	3.82	-1.04	5.94
Disgust	-1.78	2.79	-1.73	4.07
Fcz				
Neutral	-0.68	2.15	-0.66	2.61
Violent	-0.11	2.48	-0.78	2.91
Erotic	-2.61	3.35	-0.90	4.83
Disgust	-1.94	2.30	-1.59	3.24
Cz				
Neutral	0.11	1.44	0.01	1.74
Violent	0.72	3.31	0.15	2.02
Erotic	-0.33	2.68	1.26	1.73
Disgust	0.05	1.99	1.08	1.91
Pz				
Neutral	1.45	1.84	1.32	2.29
Violent	2.76	3.64	1.86	2.00
Erotic	1.43	2.34	3.07	2.55
Disgust	1.78	2.19	3.44	2.78

4.6.2.6 50 – 150ms Post Stimuli (100ms)

Table 39. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who have, and have not been victims or witnesses to a violent crime across all measurement sites for each image category for the 100ms timeframe.

100ms	Males (n=35)				Females (n=43)			
	Yes (n=14)		No (n=21)		Yes (n=14)		No (n=29)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-0.31	2.05	-0.18	2.18	-1.39	1.21	-1.25	2.26

Violent	-0.80	1.89	-1.53	1.19	-1.49	1.66	-1.58	1.83
Erotic	-1.55	1.47	-1.31	2.76	-0.72	1.30	-1.03	2.93
Disgust	0.07	1.25	-0.78	1.43	-1.18	1.20	-1.55	2.07
Fcz								
Neutral	-0.84	1.73	-0.75	1.49	-1.50	1.31	-1.54	1.91
Violent	-0.97	1.73	-1.70	1.09	-1.61	1.70	-1.72	1.48
Erotic	-1.98	1.58	-1.24	2.28	-0.98	1.03	-1.26	2.25
Disgust	-0.71	1.51	-1.07	1.24	-1.48	1.16	-1.75	1.82
Cz								
Neutral	-1.98	0.98	-1.71	1.59	-0.62	1.33	-0.83	1.19
Violent	-1.15	1.80	-2.03	1.04	-1.02	1.54	-0.97	1.32
Erotic	-2.10	1.09	-1.19	1.01	-1.11	0.72	-0.64	1.22
Disgust	-1.35	1.07	-1.15	1.57	-1.30	0.82	-1.02	1.22
Pz								
Neutral	-0.73	2.18	-0.57	2.79	0.69	1.38	0.75	2.08
Violent	-0.18	2.98	-0.88	1.81	0.49	1.14	0.87	1.63
Erotic	-0.42	1.25	-0.13	1.69	-0.40	1.68	1.21	2.29
Disgust	-0.12	2.11	0.62	3.01	-0.33	1.51	1.03	1.90

4.6.2.7 150 – 250ms Post Stimuli (200ms)

Table 40. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who have, and have not, been victims or witnesses to a violent crime across the all measurement sites for each image category for the 200ms timeframe.

200ms	Males (n=35)				Females (n=43)			
	Yes (n=14)		No (n=21)		Yes (n=14)		No (n=29)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.98	2.82	-1.69	3.46	-3.40	2.63	-3.50	3.76
Violent	-0.96	3.73	-1.58	3.98	-1.77	3.15	-2.35	3.46
Erotic	0.34	2.43	1.69	4.81	0.65	2.59	0.83	4.97

Disgust	-0.45	2.92	-1.48	4.17	-1.66	2.62	-3.14	2.96
Fcz								
Neutral	-2.45	2.07	-2.08	3.16	-3.18	2.42	-3.29	3.16
Violent	-1.42	3.59	-2.04	3.88	-2.30	2.37	-2.77	2.77
Erotic	-0.32	2.62	1.24	4.26	-0.09	1.92	0.07	3.87
Disgust	-1.07	2.79	-1.66	3.99	-1.84	2.39	-3.09	2.72
Cz								
Neutral	-1.71	1.65	-1.90	3.56	-0.08	2.29	-0.01	1.81
Violent	-1.89	2.88	-3.02	4.23	-0.11	2.67	-0.72	1.76
Erotic	-0.54	1.89	0.35	3.55	-0.47	1.48	0.34	1.96
Disgust	-0.79	2.47	-1.32	3.99	-0.55	1.87	-0.40	1.32
Pz								
Neutral	1.44	2.58	0.83	2.74	3.00	3.30	3.59	3.12
Violent	0.26	3.49	-0.84	2.04	2.87	3.50	2.87	2.62
Erotic	0.02	2.28	0.40	2.70	0.63	2.36	2.39	2.55
Disgust	0.93	2.99	0.77	3.56	1.28	3.86	3.13	2.22

4.6.2.8 250 – 450ms Post Stimuli (300ms)

Table 41. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who have, and have not been victims or witnesses to a violent crime across the all measurement sites for each image category for the 300ms timeframe.

300ms	Males (n=35)				Females (n=43)			
	Yes (n=14)		No (n=21)		Yes (n=14)		No (n=29)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-2.14	2.73	-1.06	3.30	-2.11	3.04	-2.13	3.84
Violent	-0.09	4.68	-1.12	5.56	-0.43	4.28	-0.37	4.19
Erotic	0.09	2.58	1.34	4.35	-1.11	2.91	1.12	6.42
Disgust	-1.79	2.19	-1.02	3.25	-2.08	3.58	-2.06	4.29
Fcz								

Neutral	-3.13	2.09	-1.77	3.13	-2.65	2.53	-2.79	3.17
Violent	-1.04	4.66	-1.87	5.38	-1.70	3.38	-1.60	3.34
Erotic	-0.95	2.24	0.57	3.60	-1.71	2.26	-0.15	5.12
Disgust	-2.56	2.20	-1.40	3.07	-2.62	3.15	-2.78	3.64
Cz								
Neutral	-3.19	2.65	-1.68	3.49	-1.14	1.96	-1.65	1.94
Violent	-2.64	3.67	-2.71	4.29	-0.25	3.58	-0.91	2.09
Erotic	-1.42	1.85	0.16	3.36	-1.18	2.07	0.08	2.46
Disgust	-2.29	2.72	-1.16	3.45	-1.14	2.57	-0.72	2.04
Pz								
Neutral	0.75	2.04	1.08	3.20	1.82	2.41	2.30	2.62
Violent	0.72	3.68	0.78	3.19	3.64	3.60	3.28	2.96
Erotic	2.43	2.20	2.39	3.88	1.50	2.50	3.78	3.30
Disgust	2.03	2.32	2.83	4.68	2.25	3.53	3.99	2.74

4.6.2.9 450 – 650ms Post Stimuli (ELPP)

Table 42. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who have, and have not, been victims or witnesses to a violent crime across all measurement sites for each image category for the ELPP timeframe.

ELPP	Males (n=35)				Females (n=43)			
	Yes (n=14)		No (n=21)		Yes (n=14)		No (n=29)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.06	3.38	-0.68	2.94	-1.71	2.99	-0.65	3.60
Violent	-0.55	4.00	-1.70	4.70	0.01	3.56	0.29	3.73
Erotic	-2.82	4.68	-2.73	5.82	-4.34	2.75	-0.41	7.78
Disgust	-1.86	2.71	-3.04	4.77	-2.26	2.99	-1.79	4.87
Fcz								
Neutral	-2.07	2.83	-1.23	2.79	-2.00	2.43	-1.28	2.91
Violent	-1.17	3.71	-2.09	4.68	-0.76	2.75	-0.67	2.94

Erotic	-3.03	4.31	-2.63	5.16	-4.00	2.55	-0.60	5.93
Disgust	-2.48	2.74	-2.65	4.22	-2.23	2.58	-1.95	3.87
Cz								
Neutral	-1.17	2.53	-0.59	2.95	-0.13	1.80	-0.45	1.39
Violent	-0.80	2.04	-1.18	3.60	1.23	4.44	0.32	1.65
Erotic	-0.48	2.61	0.24	2.99	-0.64	2.89	2.01	2.20
Disgust	-0.80	2.32	-0.47	2.70	0.12	2.31	1.28	2.54
Pz								
Neutral	1.98	2.02	1.48	3.17	2.00	2.32	1.92	2.22
Violent	3.11	2.63	2.19	3.09	3.91	4.38	2.83	2.33
Erotic	3.77	1.80	4.74	3.60	1.95	2.16	4.42	3.92
Disgust	2.99	2.56	3.89	4.29	2.57	2.38	4.56	2.54

4.6.2.10 650 – 850ms Post Stimuli (LLPP)

Table 43. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who have, and have not been victims or witnesses to a violent crime across all measurement sites for each image category for the LLPP timeframe

LLPP	Males (n=35)				Females (n=43)			
	Yes (n=14)		No (n=21)		Yes (n=14)		No (n=29)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	0.53	2.79	-0.77	3.29	-1.09	2.58	-0.01	2.81
Violent	-0.32	2.92	-1.39	3.69	0.97	3.27	0.35	2.99
Erotic	-1.47	3.34	-1.90	4.00	-4.01	3.95	-0.42	7.02
Disgust	-1.67	2.31	-2.09	3.87	-1.89	3.29	-1.47	4.25
Fcz								
Neutral	-0.27	2.20	-0.99	2.95	-1.10	2.09	-0.42	2.37
Violent	-0.47	2.55	-1.44	3.51	0.25	2.44	-0.30	2.33
Erotic	-1.64	3.12	-1.68	3.34	-3.58	3.40	-0.34	5.66
Disgust	-1.94	2.01	-1.71	3.46	-1.93	2.64	-1.51	3.12

Cz								
Neutral	0.06	1.54	-0.03	2.38	0.15	1.39	0.05	1.13
Violent	0.29	1.64	-0.62	2.53	1.14	4.44	0.71	1.34
Erotic	0.25	2.35	0.53	1.76	-0.90	2.94	1.78	1.53
Disgust	0.00	1.59	0.47	1.95	0.10	2.39	1.52	1.79
Pz								
Neutral	1.48	2.20	1.33	2.99	1.43	1.47	1.31	1.66
Violent	2.44	2.69	1.50	2.01	3.07	4.48	2.12	1.98
Erotic	2.37	1.92	3.15	2.29	0.49	2.41	3.01	2.76
Disgust	1.55	2.40	3.10	3.29	2.02	2.01	3.68	2.38

A visual representation of these results has been provided using ERP waveforms below (see Figure 52 – 81).

Males

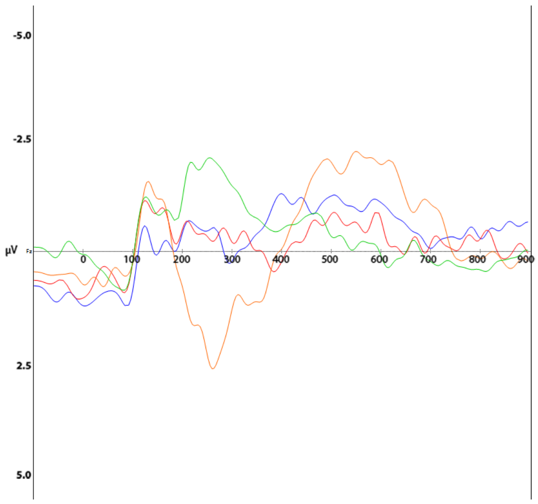


Figure 52. Grand average ERP waveform (microvolts) for males at the Fz location, across time (milliseconds).

Females

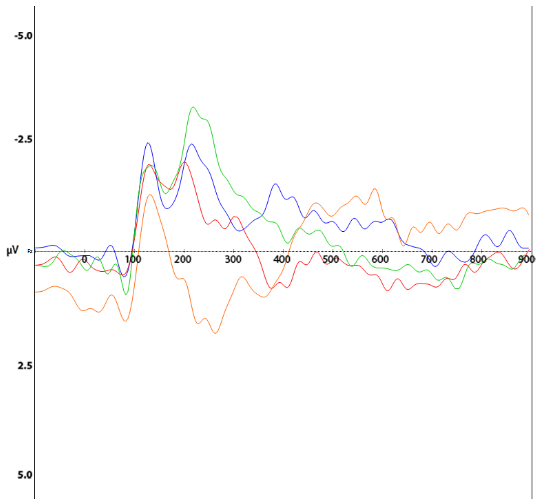


Figure 53. Grand average ERP waveform (microvolts) for females at the Fz location, across time (milliseconds).

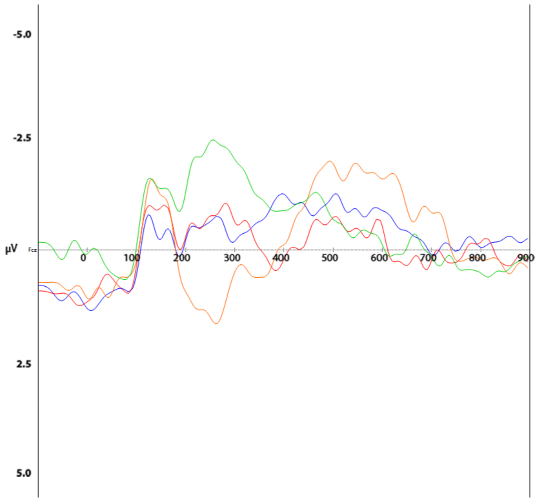


Figure 54 . Grand average ERP waveform (microvolts) for males at the Fcz location, across time (milliseconds).

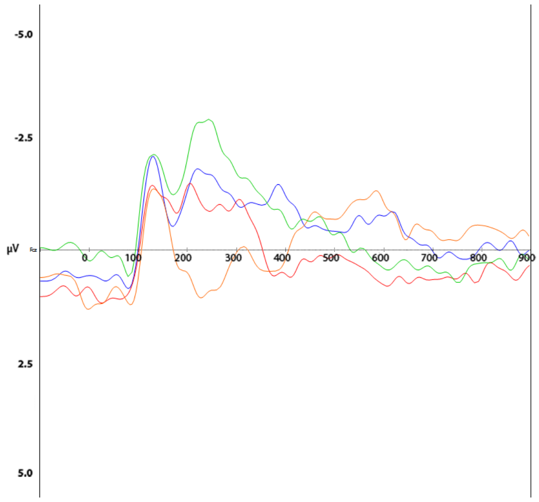


Figure 55. Grand average ERP waveform (microvolts) for females at the Fcz location, across time (milliseconds).

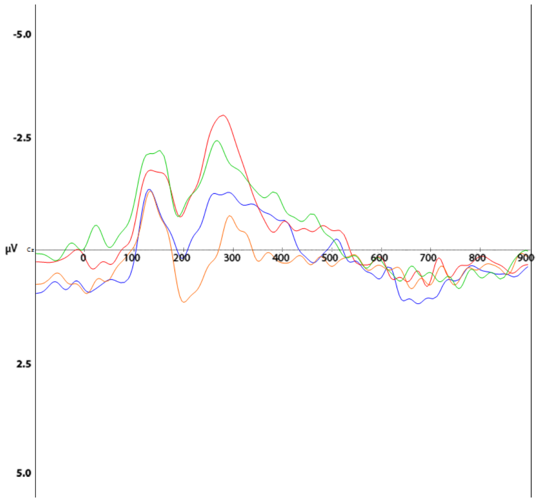


Figure 56. Grand average ERP waveform (microvolts) for males at the Cz location, across time (milliseconds).

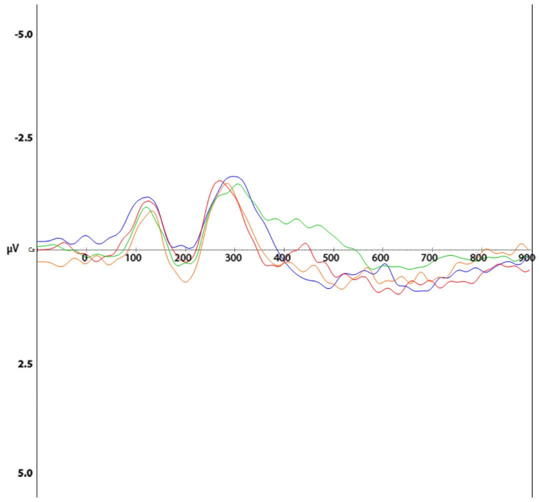
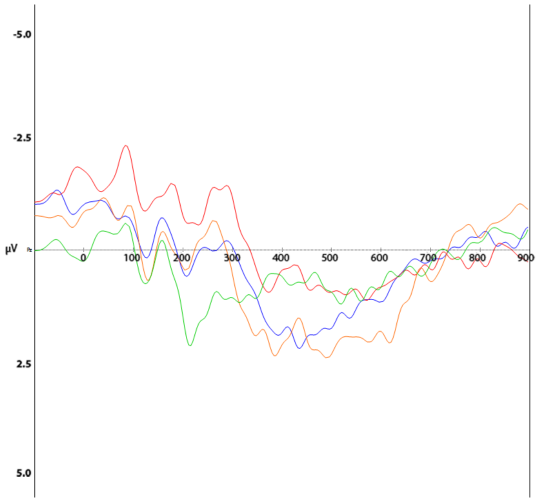


Figure 57. Grand average ERP waveform (microvolts) for females at the Cz location, across time (milliseconds).



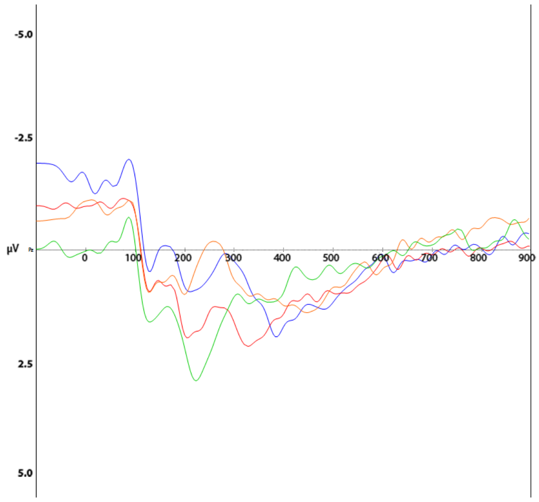


Figure 58. Grand average ERP waveform (microvolts) for males at the Pz location, across time (milliseconds).

Figure 59. Grand average ERP waveform (microvolts) for females at the Pz location, across time (milliseconds).

Witness/Victim of a Violent Crime

Yes

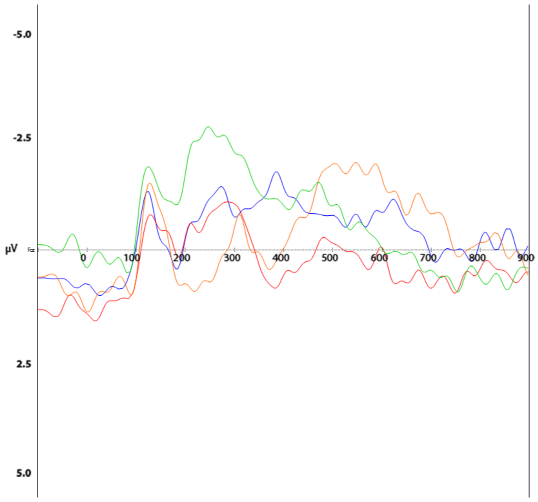


Figure 60. Grand average ERP waveform (microvolts) for participants who had been a witness or victim to a violent crime at the Fcz location, across time (milliseconds).

No

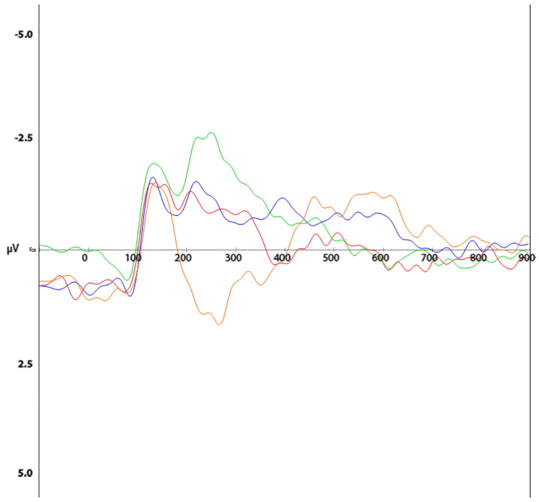
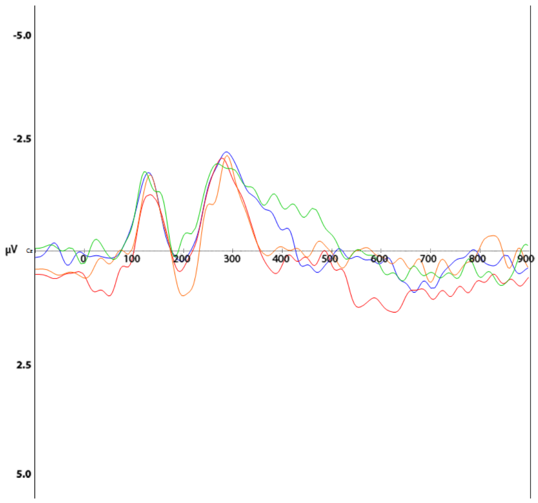


Figure 61. Grand average ERP waveform (microvolts) for participants who had not been a witness or victim to a violent crime at the Fcz location, across time (milliseconds).



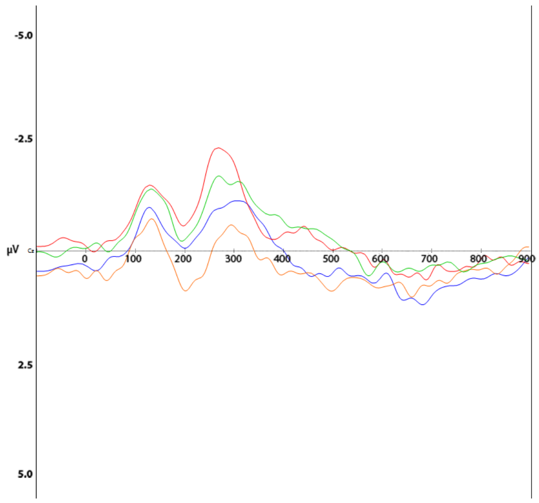
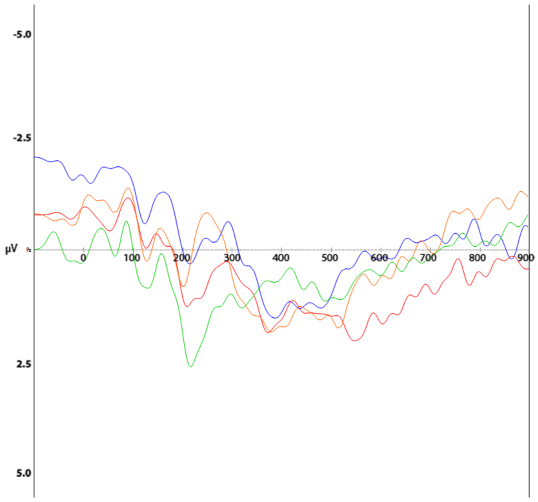


Figure 62. Grand average ERP waveform (microvolts) for participants who had been a witness or victim to a violent crime at the Cz location, across time (milliseconds).

Figure 63. Grand average ERP waveform (microvolts) for participants who had not been a witness or victim to a violent crime at the Cz location, across time (milliseconds).



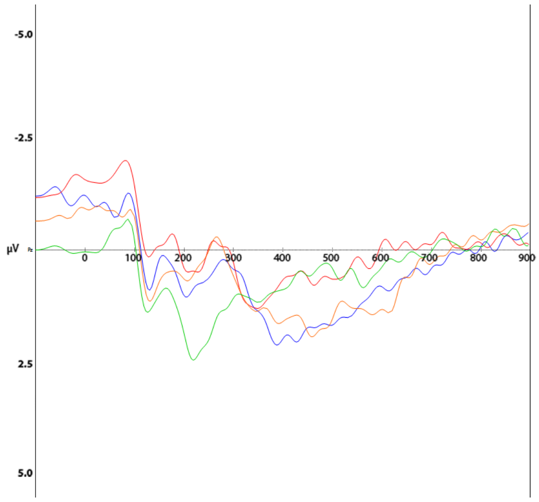
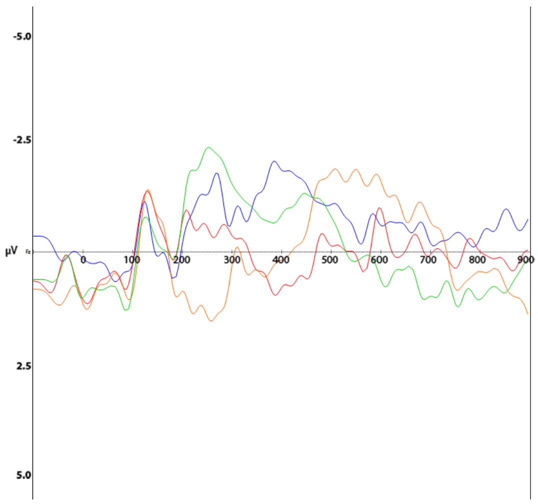


Figure 64. Grand average ERP waveform (microvolts) for participants who had been a witness or victim to a violent crime at the Pz location, across time (milliseconds).

Figure 65. Grand average ERP waveform (microvolts) for participants who had not been a witness or victim to a violent crime at the Pz location, across time (milliseconds).

Males



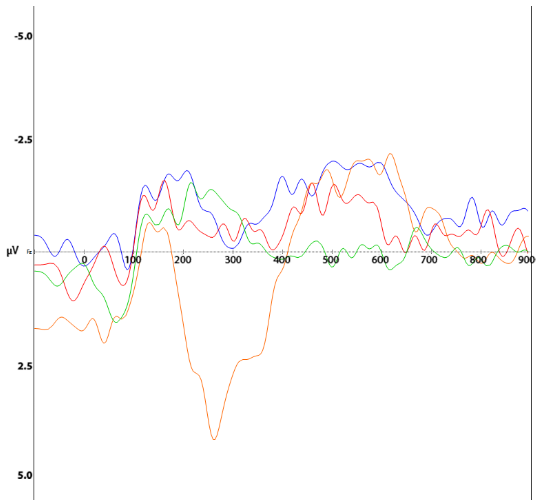


Figure 66. Grand average ERP waveform (microvolts) for males who had been a witness or victim to a violent crime at the Fz location, across time (milliseconds).

Figure 67 Grand average ERP waveform (microvolts) for males who had not been a witness or victim to a violent crime at the Fz location, across time (milliseconds).

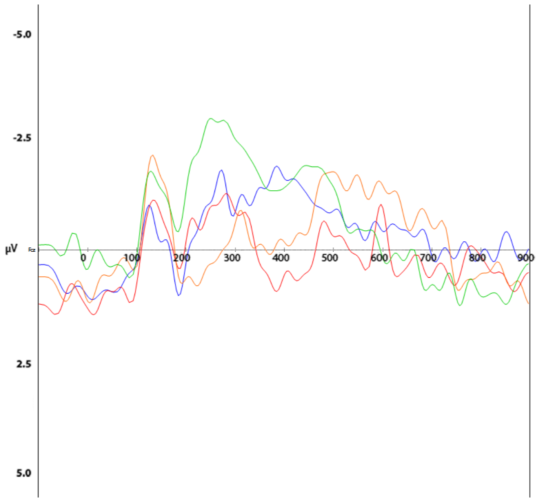


Figure 68. Grand average ERP waveform (microvolts) for males who had been a witness or victim to a violent crime at the Fcz location, across time (milliseconds).

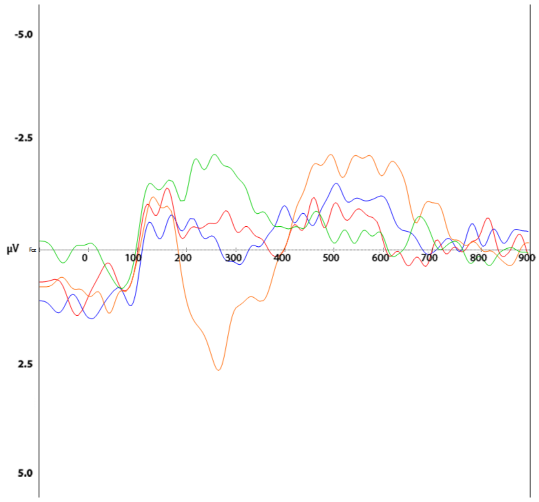


Figure 69. Grand average ERP waveform (microvolts) for males who had not been a witness or victim to a violent crime at the Fcz location, across time (milliseconds).

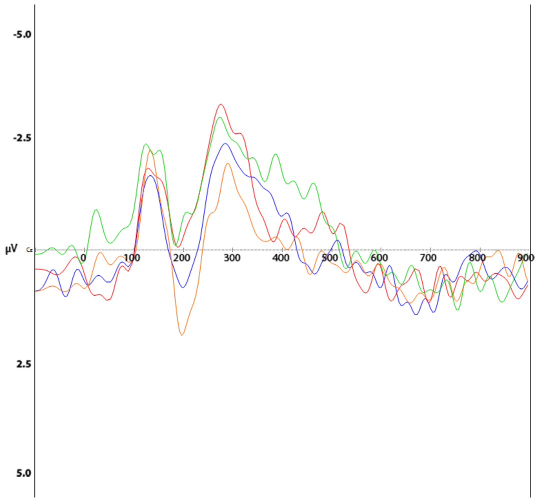


Figure 70. Grand average ERP waveform (microvolts) for males who had been a witness or victim to a violent crime at the Cz location, across time (milliseconds).

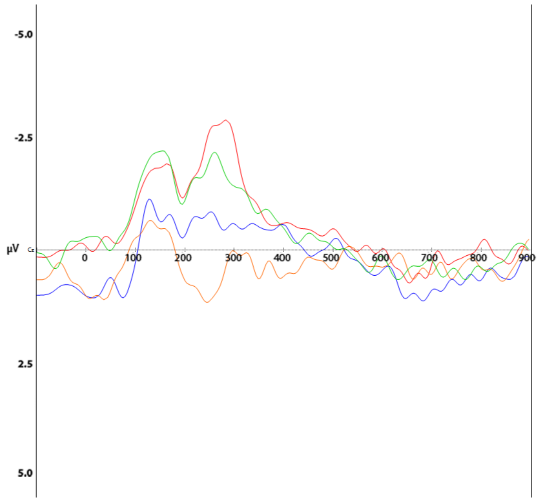


Figure 71. Grand average ERP waveform (microvolts) for males who had not been a witness or victim to a violent crime at the Cz location, across time (milliseconds).

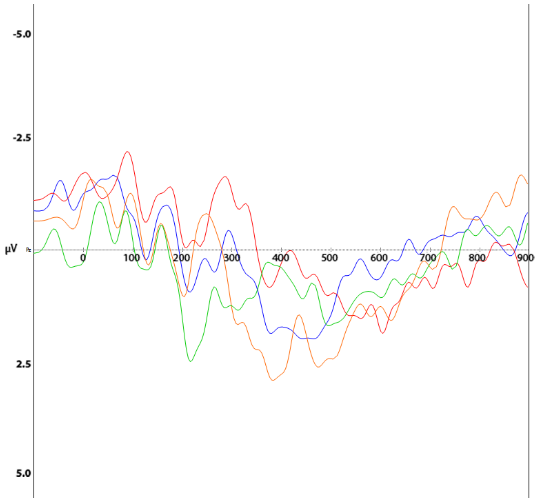


Figure 72. Grand average ERP waveform (microvolts) for males who had been a witness or victim to a violent crime at the Pz location, across time (milliseconds).

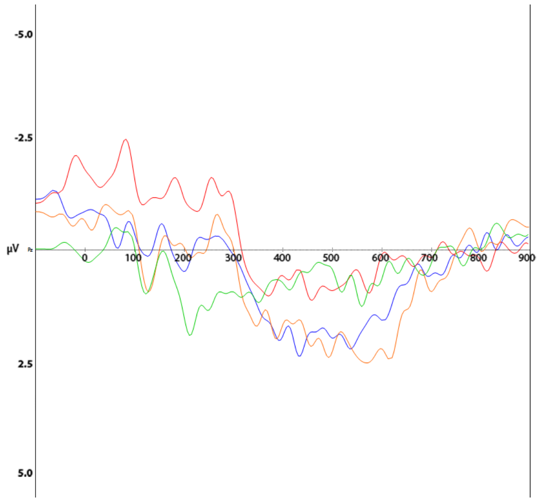


Figure 73. Grand average ERP waveform (microvolts) for males who had not been a witness or victim to a violent crime at the Pz location, across time (milliseconds).

Females

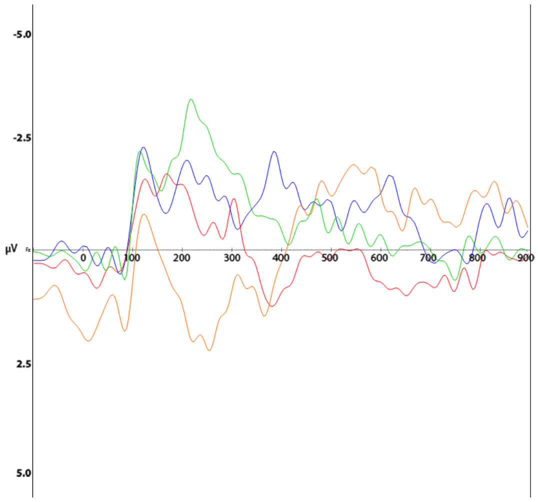


Figure 74. Grand average ERP waveform (microvolts) for females who had been a witness or victim to a violent crime at the Fz location, across time (milliseconds).

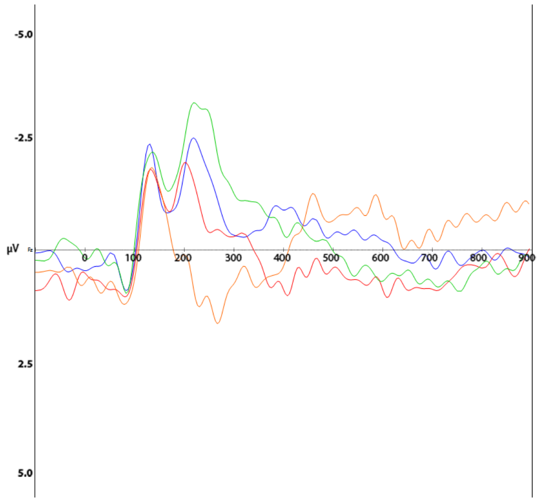


Figure 75. Grand average ERP waveform (microvolts) for females who had not been a witness or victim to a violent crime at the Fz location, across time (milliseconds).

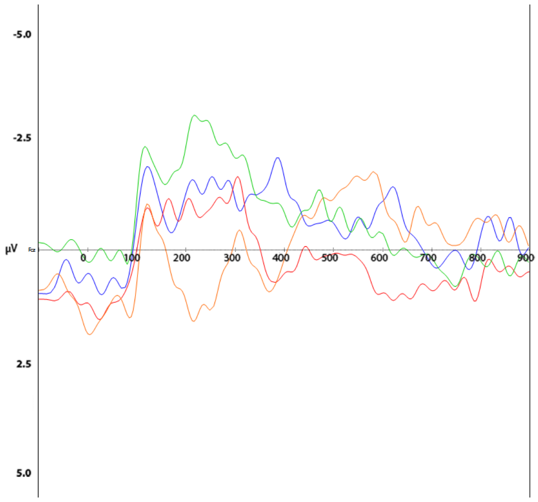


Figure 76. Grand average ERP waveform (microvolts) for females who had been a witness or victim to a violent crime at the Fcz location, across time (milliseconds).

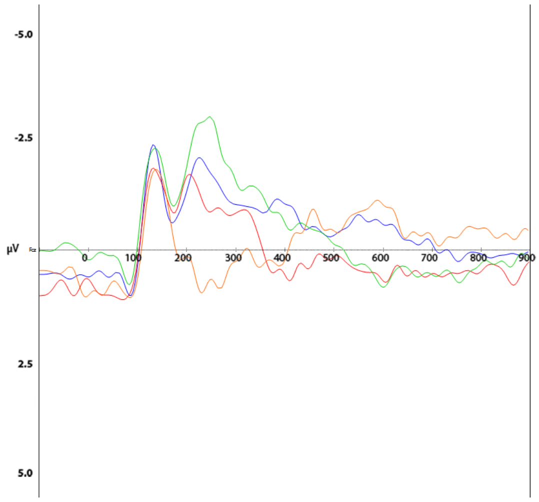


Figure 77 Grand average ERP waveform (microvolts) for females who had not been a witness or victim to a violent crime at the Fcz location, across time (milliseconds).

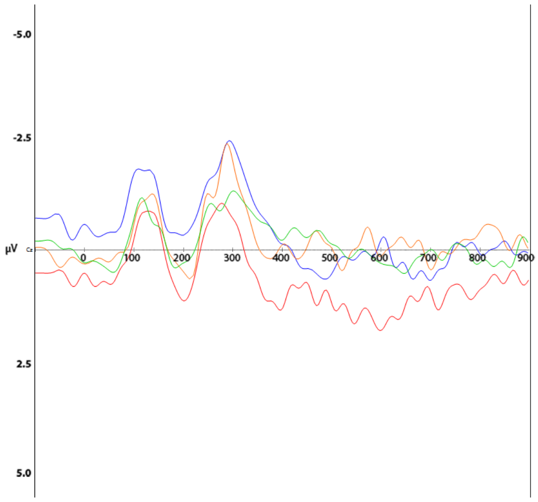


Figure 78. Grand average ERP waveform (microvolts) for females who had been a witness or victim to a violent crime at the Cz location, across time (milliseconds).

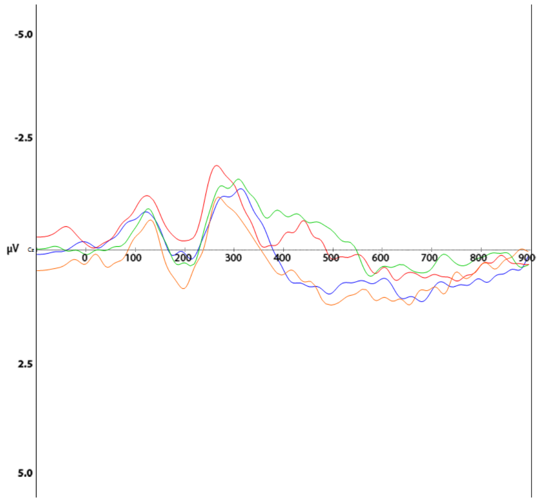


Figure 79. Grand average ERP waveform (microvolts) for females who had not been a witness or victim to a violent crime at the Cz location, across time (milliseconds).

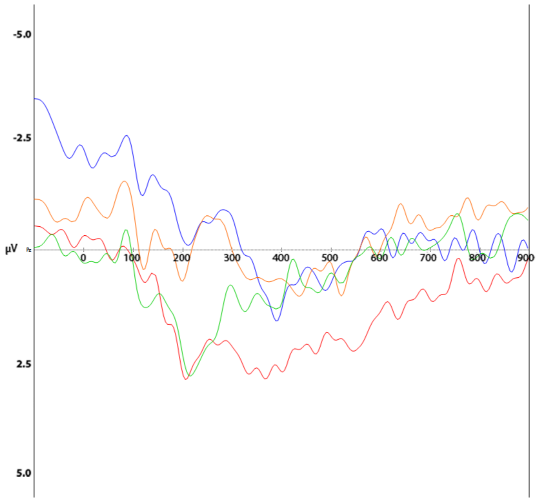


Figure 80. Grand average ERP waveform (microvolts) for females who had been a witness or victim to a violent crime at the Pz location, across time (milliseconds).

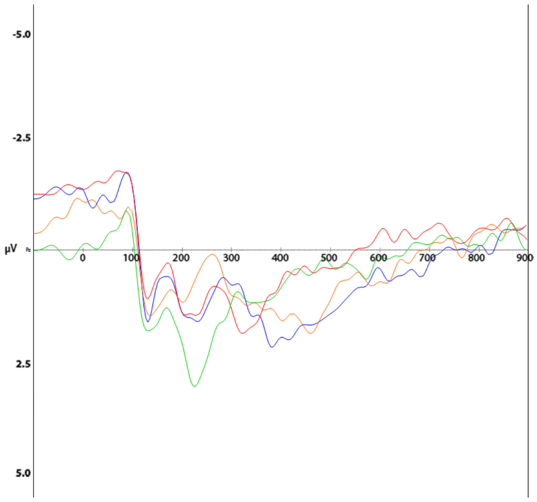


Figure 81. Grand average ERP waveform (microvolts) for females who had not been a witness or victim to a violent crime at the Pz location, across time (milliseconds).

Table 44. Significant main and interaction effects across electrode and epoch on grand mean ERP amplitudes in response towards the four image categories.

Site	Epoch	Effect			
		Sex	Image	Witness/Victim to Violent Crime	Interactions
Fz	100ms	F(1, 74)= 5.42, p=0.01, ηp2=.06			Sex x Image F(3, 74)= 5.07, p<0.001, ηp2=.06
	200ms		F(3, 74)= 24.54, p<0.001, ηp2=.25		
	300ms		F(3, 74)= 10.55, p<0.001, ηp2=.13		
	ELPP		F(3, 74)= 7.17, p<0.001, ηp2=.09		
	LLPP				
Fcz	100ms				Sex x Image F(3, 74)= 4.05, p<0.001, ηp2=.05
	200ms		F(3, 74)= 30.10, p<0.001, ηp2=.29		
	300ms	F(1, 74)= 5.68, p=0.01, ηp2=.06	F(3, 74)= 5.42, p<0.001, ηp2=.07		Sex x Image F(3, 74)= 4.95, p<0.001, ηp2=.06

	ELPP		$F(3, 74)= 4.66$, $p<0.001$, $\eta p2=.06$		
	LLPP				
Cz	100ms	$F(1, 74)= 7.62$, $p<0.001$, $\eta p2=.09$			Sex x Image $F(3, 74)= 4.00$, $p<0.001$, $\eta p2=.05$ WVtVC x Image $F(3, 74)= 4.51$, $p<0.001$, $\eta p2=.09$
	200ms	$F(1, 74)= 5.05$, $p=0.05$, $\eta p2=.05$	$F(3, 74)= 11.10$, $p<0.001$, $\eta p2=.13$		Sex x Image $F(3, 74)= 8.08$, $p<0.001$, $\eta p2=.10$ WVtVC x Image $F(3, 74)= 8.89$, $p=0.01$, $\eta p2=.10$
	300ms		$F(3, 74)= 9.64$, $p<0.001$, $\eta p2=.12$		Sex x Image $F(3, 74)= 5.20$, $p<0.001$, $\eta p2=.07$ WVtVC x Image $F(3, 74)= 4.07$, $p<0.001$, $\eta p2=.06$

	ELPP	F(1, 74)= 5.11, p=0.03, ηp2=.07	F(3, 74)= 3.10, p=0.03, ηp2=.04		WVtVC x Image F(3, 74)= 5.69, p<0.001, ηp2=.07
	LLPP				
Pz	100ms	F(1, 74)= 5.01, p=0.03, ηp2=.07			WVtVC x Image F(3, 74)= 2.73, p=0.05, ηp2=.04
	200ms	F(1, 74)= 12.85, p<0.001, ηp2=.15	F(3, 74)= 6.46, p<0.001, ηp2=.08		
	300ms	F(1, 74)= 5.68, p=0.01, ηp2=.0.05	F(3, 74)= 5.45, p<0.001, ηp2=.07		Sex x Image F(3, 74)= 4.95, p<0.01, ηp2=.06
	ELPP		F(3, 74)= 10.00, p<0.001, ηp2=.12		
	LLPP		F(3, 74)= 3.80, p=0.01, ηp2=.05		

Table 45. Significant p-values from independent T-tests for the effect of sex, across site and epoch (adjusted alpha value =0.025).

	Epoch				
Region and Image Category	100	200	300	ELPP	LLPP
Fz					
Violent					
Erotic					
Disgust	t=2.62, df=76, p=0.01, d=0.61				
Neutral	t=2.31, df=76, p=0.02, d=0.53				
Fcz					
Violent					
Erotic					
Disgust					
Neutral					
Cz					
Violent		t=-3.06, df=76, p<0.01, d=0.68		t=-2.46, df=76, p<0.01, d=0.56	

Erotic	t=-3.58, df=76, p<0.01, d=0.67				
Disgust				t=-2.64, df=76, p<0.01, d=0.60	
Neutral	t=-3.56, df=76, p<0.01, d=0.81	t=-3.22, df=76, p<0.01, d=0.72			
Pz					
Violent	t=-3.08, df=76, p<0.01, d=0.68	t=-5.10, df=76, p<0.001, d=1.17	t=-3.58, df=76, p<0.01, d=0.81		
Erotic		t=-2.79, df=76, p<0.01, d=0.61			
Disgust		t=-2.39, df=76, p=0. 02, d=0.55			
Neutral	t=-2.75, df=76, p<0.01, d=0.61	t=-3.47, df=76, p<0.01, d=0.80			

Table 46. Significant P–values for pairwise comparisons across the effect of image across site and epoch.

Site	Epoch	Effect		
		Image	Difference Between Groups	P-value*
Fz	200ms	F(3, 74)= 24.54, p<0.001, ηp2=.25	Violent – Erotic	<0.01, d=0.72
			Violent – Neutral	<0.01, d=0.26
			Erotic – Disgust	<0.01, d=0.76

			Erotic - Neutral	<0.01, d=0.96
	300ms	F(3, 74)= 10.55, p<0.001, ηp2=.13	Violent – Disgust	=0.03, d=0.29
			Violent - Neutral	=0.01, d=0.33
			Erotic – Disgust	<0.01, d=0.55
			Erotic - Neutral	<0.01, d=0.58
	ELPP	F(3, 74)= 7.17, p<0.001, ηp2=.09	Violent - Erotic	=<0.01, d=0.33
			Violent - Disgust	<0.01, d=0.43
			Disgust - Neutral	=0.02, d=0.34
Fcz	200ms	F(3, 74)= 30.10, p<0.001, ηp2=.29	Violent – Erotic	<0.01, d=0.76
			Erotic – Disgust	<0.01, d=0.72
			Erotic - Neutral	<0.01, d=0.96
			Disgust - Neutral	<0.01, d=0.23
	300ms	F(3, 74)= 5.42, p<0.001, ηp2=.07	Erotic – Disgust	<0.01, d=0.55
			Erotic - Neutral	<0.01, d=0.63
	ELPP	F(3, 74)= 4.66, p<0.001, ηp2=.06	Violent - Disgust	=0.01, d=0.32
Cz	200ms	F(3, 74)= 24.54, p<0.001, ηp2=.25	Violent – Erotic	<0.01, d=0.72
			Violent - Disgust	=0.01, d=0.32
			Erotic - Neutral	<0.01, d=0.72

	300ms	F(3, 74)= 10.55, p<0.001, ηp2=.13	Violent –Erotic	<0.01, d=0.26
			Erotic – Disgust	=0.02, d=0.32
			Erotic - Neutral	<0.01, d=0.26
	ELPP	F(3, 74)= 7.17, p<0.001, ηp2=.09	Erotic – Disgust	<0.01, d=0.76
Pz	200ms	F(3, 74)= 6.46, p<0.001, ηp2=.08	Violent - Neutral	=0.01, d=0.30
			Erotic - Neutral	<0.01, d=0.43
	300ms	F(3, 74)= 5.45, p<0.001, ηp2=.07	Erotic - Neutral	=0.01, d=0.38
			Disgust - Neutral	<0.01, d=0.45
	ELPP	F(3, 74)= 10.00, p<0.001, ηp2=.12	Erotic - Neutral	<0.01, d=1.13
			Disgust - Neutral	<0.01, d=1.02
			Violent - Neutral	=0.03, d=0.57
	LLPP	F(3, 74)= 3.80, p=0.01, ηp2=.05	Disgust - Neutral	=0.02, d=0.89

*Values adjusted for multiple comparisons using Bonferroni correction

There were no main effects found dependant on whether participants had been a witness or victim to a violent crime. However, there were several effects analysed showing interactions between sex x image and previous victim to a violent crime x image (see Table 44-46). There were no patterns found across either variable but, it was shown that ERP amplitude was inconsistent across sex and the PWVC variable.

4.6.3 Section 3: Sex x Preference Towards Playing Violent or Non-Violent Video Games x Image

This is the analysis of sex differences, whether or not participants preferred playing violent or non-violent video games by location and epoch in response to affective images. Means and standard deviations have been provided in the below sequence of tables (see Table 47 – 56.). The data was analysed using mixed ANOVA (Sex, 2 levels: Male and Female x Preference towards playing violent or non-violent video games, 2 levels; Violent and Non-Violent x Image, 4 levels: Neutral, Violent, Disgust and Erotic). Bonferroni adjusted post-hoc tests for more than two comparisons (e.g. image) and independent t-test (with alpha adjusted to .025) for sex were conducted. Only significant results have been provided below.

4.6.3.1 50 – 150ms Post Stimuli (100ms)

Table 47. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who prefer to play either violent or non-violent videogames across all measurement sites, for each image category within the 100ms timeframe.

100ms	Violent (n=22)		Non-Violent (n=24)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-0.41	2.54	-1.27	1.67
Violent	-0.98	1.15	-1.98	1.67
Erotic	-1.30	2.15	-1.03	2.89
Disgust	-0.58	1.85	-0.96	1.52
Fcz				
Neutral	-0.99	1.81	-1.55	1.48
Violent	-1.13	1.23	-2.11	1.36

Erotic	-1.53	1.63	-1.13	2.36
Disgust	-1.20	1.50	-1.36	1.55
Cz				
Neutral	-1.09	1.77	-1.43	1.41
Violent	-1.00	1.74	-1.57	1.47
Erotic	-1.52	1.08	-0.92	1.23
Disgust	-1.12	1.26	-1.34	1.29
Pz				
Neutral	0.46	2.69	-0.54	2.40
Violent	0.55	1.61	-0.35	2.76
Erotic	-0.11	1.45	-0.39	2.78
Disgust	-0.05	2.28	0.86	2.59

4.6.3.2 150 – 250ms Post Stimuli (200ms)

Table 48. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who prefer to play either violent or non-violent videogames across all measurement sites, for each image category within the 200ms timeframe.

200ms	Violent (n=22)		Non-Violent (n=24)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-1.52	3.76	-3.91	3.57
Violent	-0.56	3.82	-3.14	3.80
Erotic	2.03	3.91	1.64	5.19
Disgust	-0.78	3.52	-2.75	3.84
Fcz				
Neutral	-1.93	3.10	-3.88	3.10
Violent	-1.18	3.43	-3.50	3.71
Erotic	1.23	3.04	0.89	4.70
Disgust	-1.39	3.23	-2.91	3.76
Cz				
Neutral	-0.36	2.51	-1.64	3.57

Violent	-0.77	3.41	-2.73	3.93
Erotic	0.53	2.11	-0.25	3.42
Disgust	-0.36	2.56	-1.55	3.50
Pz				
Neutral	2.19	2.91	2.07	3.86
Violent	1.25	3.52	0.51	3.76
Erotic	0.24	1.31	0.48	3.80
Disgust	0.67	3.44	2.39	3.15

4.6.3.3 250 – 450ms Post Stimuli (300ms)

Table 49. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who prefer to play either violent or non-violent videogames across all measurement sites, for each image category within the 300ms timeframe.

300ms	Violent (n=22)		Non-Violent (n=24)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-0.63	4.44	-3.33	2.04
Violent	0.59	5.47	-2.99	3.86
Erotic	1.34	5.75	1.15	5.18
Disgust	-0.91	4.35	-2.72	2.99
Fcz				
Neutral	-1.71	3.88	-3.76	1.80
Violent	-0.87	5.14	-3.44	3.84
Erotic	0.12	4.62	0.31	4.21
Disgust	-1.82	4.16	-3.26	2.39
Cz				
Neutral	-0.84	3.14	-2.64	2.65
Violent	-0.77	4.71	-2.93	3.12
Erotic	-0.01	2.90	-0.53	3.37
Disgust	-0.89	3.60	-2.13	2.57
Pz				

Neutral	2.28	2.48	1.27	3.05
Violent	2.36	3.69	1.75	4.19
Erotic	2.27	2.63	2.48	4.26
Disgust	2.44	2.75	3.49	4.40

4.6.3.4 450 – 650ms Post Stimuli (ELPP)

Table 50. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who prefer to play either violent or non-violent videogames across all measurement sites, for each image category within the ELPP timeframe.

ELPP	Violent (n=22)		Non-Violent (n=24)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-0.06	4.04	-2.09	2.27
Violent	-0.09	4.87	-2.49	3.31
Erotic	-2.96	6.35	-1.26	7.98
Disgust	-1.62	4.05	-3.45	5.46
Fcz				
Neutral	-1.05	3.40	-2.50	2.10
Violent	-0.85	4.52	-2.80	3.16
Erotic	-2.98	5.39	-1.55	6.51
Disgust	-1.90	3.95	-3.39	4.20
Cz				
Neutral	0.39	2.39	-1.16	2.36
Violent	0.83	4.33	-1.20	2.66
Erotic	0.30	2.78	0.41	3.66
Disgust	-0.01	3.29	-0.22	2.82
Pz				
Neutral	2.65	2.57	1.62	2.36
Violent	3.46	3.91	3.25	3.14
Erotic	3.91	2.86	3.81	4.69
Disgust	3.25	2.57	4.74	3.82

4.6.3.5 650 – 850ms Post Stimuli (LLPP)

Table 51. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who preferred to play either violent or non-violent videogames across all measurement sites, for each image category within the LLPP timeframe.

LLPP	Violent (n=22)		Non-Violent (n=24)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	0.42	3.26	-1.49	2.74
Violent	0.50	4.21	-1.68	2.67
Erotic	-2.46	4.51	-0.22	7.55
Disgust	-1.18	2.00	-2.25	4.99
Fcz				
Neutral	-0.20	2.66	-1.66	2.46
Violent	0.07	3.82	-1.67	2.03
Erotic	-2.24	3.46	-0.30	6.53
Disgust	-1.40	2.40	-2.26	3.65
Cz				
Neutral	0.93	1.66	-0.58	1.91
Violent	1.32	4.12	-0.54	1.47
Erotic	0.27	1.90	0.60	3.08
Disgust	0.59	2.40	0.38	2.16
Pz				
Neutral	2.05	2.69	1.26	1.95
Violent	2.72	3.70	2.23	2.71
Erotic	2.41	2.51	2.05	3.18
Disgust	2.55	2.32	3.49	3.42

4.6.3.6 50 – 150ms Post Stimuli (100ms)

Table 52. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who prefer to play either violent or non- violent videogames across all measurement sites, for each image category within the 100ms timeframe.

100ms	Males (n=30)				Females (n=16)			
	Violent (n=13)		Nonviolent (n=17)		Violent (n=9)		Nonviolent (n=7)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	0.20	2.70	-0.48	1.13	-1.30	2.12	-2.80	1.86
Violent	-1.02	1.42	-1.32	1.21	-0.91	0.64	-3.39	1.74
Erotic	-2.16	1.90	-0.84	2.43	-0.05	1.95	-1.15	3.95
Disgust	-0.17	1.86	-0.65	1.01	-1.17	1.76	-1.83	2.16
Fcz								
Neutral	-0.54	1.88	-0.94	0.95	-1.63	1.60	-2.71	1.95
Violent	-1.16	1.48	-1.53	1.00	-1.08	0.83	-3.33	1.34
Erotic	-2.10	1.49	-1.04	2.26	-0.70	1.53	-1.01	2.77
Disgust	-0.80	1.51	-1.04	1.31	-1.78	1.35	-2.19	1.77
Cz								
Neutral	-1.74	1.80	-1.90	1.21	-0.16	1.30	-0.23	1.02
Violent	-1.14	1.60	-2.00	1.03	-0.79	2.02	-0.60	1.86
Erotic	-1.71	1.03	-1.20	0.95	-1.23	1.14	-0.22	1.54
Disgust	-1.17	1.43	-1.36	1.37	-1.04	1.06	-1.31	1.05
Pz								
Neutral	-0.23	3.17	-1.15	2.01	1.45	1.45	0.97	2.59
Violent	0.35	1.78	-1.26	2.56	0.83	1.38	1.64	1.96
Erotic	-0.04	1.37	-0.63	1.67	-0.21	1.64	0.38	4.49
Disgust	-0.33	2.78	0.79	2.71	0.35	1.33	0.86	2.29

4.6.3.7 150 – 250ms Post Stimuli (200ms)

Table 53. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who prefer to play either violent or non- violent videogames across all measurement sites, for each image category within the 200ms timeframe.

200ms	Males (n=30)				Females (n=16)			
	Violent (n=13)		Nonviolent (n=17)		Violent (n=9)		Nonviolent (n=7)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-0.26	3.16	-2.80	3.14	-3.33	3.98	-6.29	3.32
Violent	0.16	3.00	-2.59	3.99	-1.60	4.76	-4.48	2.77
Erotic	1.78	2.59	1.19	4.99	2.39	5.46	2.43	5.66
Disgust	0.56	3.57	-2.36	3.75	-2.72	2.51	-3.57	3.92
Fcz								
Neutral	-0.87	2.49	-3.15	2.90	-3.46	3.39	-5.42	2.99
Violent	-0.32	3.04	-3.01	4.04	-2.42	3.76	-4.66	2.18
Erotic	1.44	2.23	0.44	4.67	0.92	4.08	1.80	4.65
Disgust	-0.10	3.29	-2.50	3.75	-3.25	2.12	-3.71	3.66
Cz								
Neutral	-1.13	2.59	-2.33	3.49	0.76	2.01	0.09	3.09
Violent	-1.34	3.34	-3.61	4.22	0.04	3.54	-0.84	1.84
Erotic	0.96	1.96	-0.42	3.61	-0.08	2.27	0.41	2.82
Disgust	-0.68	2.95	-1.63	4.06	0.11	1.94	-1.05	1.15
Pz								
Neutral	0.66	2.39	1.28	3.05	4.40	2.10	3.97	4.89
Violent	-0.25	2.28	-0.43	3.40	3.41	3.98	2.44	3.89
Erotic	0.01	1.67	0.46	3.14	0.58	0.34	0.94	5.26
Disgust	-1.15	3.15	2.33	2.82	3.31	1.71	2.46	3.89

4.6.3.8 250 – 450ms Post Stimuli (300ms)

Table 54. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who prefer to play either violent or non- violent videogames across all measurement sites, for each image category within the 300ms timeframe.

300ms	Males (n=30)				Females (n=16)			
	Violent (n=13)		Nonviolent (n=17)		Violent (n=9)		Nonviolent (n=7)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	0.40	3.82	-2.53	1.75	-2.11	5.07	-4.70	2.35
Violent	1.47	5.01	-3.01	4.03	-0.68	6.15	-2.57	3.49
Erotic	2.62	4.45	0.17	3.01	-0.51	7.12	2.97	8.39
Disgust	0.18	3.30	-2.40	2.20	-2.49	5.35	-3.13	4.53
Fcz								
Neutral	-0.72	3.61	-3.24	1.60	-3.15	4.00	-4.53	2.33
Violent	0.23	5.25	-3.42	4.28	-2.44	4.83	-3.14	2.51
Erotic	1.33	3.58	-0.50	2.83	-1.62	5.57	1.82	6.39
Disgust	-0.66	3.57	-2.80	1.91	-3.50	4.57	-3.99	3.37
Cz								
Neutral	-0.74	3.67	-3.21	2.57	-0.97	2.39	-1.03	2.17
Violent	-1.32	4.77	-4.08	2.86	0.01	4.79	-0.48	1.98
Erotic	0.35	2.73	-0.74	3.23	-0.53	3.23	0.07	3.67
Disgust	-1.20	4.15	-2.14	2.66	-0.43	2.77	-1.72	2.47
Pz								
Neutral	1.69	2.86	0.66	2.82	3.14	1.58	2.61	3.16
Violent	0.68	2.08	0.88	4.24	4.78	4.25	3.50	3.44
Erotic	1.86	2.59	2.84	3.88	2.88	2.72	1.83	5.11
Disgust	1.21	2.87	3.59	4.75	4.21	1.26	3.29	3.26

4.6.3.9 450 – 650ms Post Stimuli (ELPP)

Table 55. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who prefer to play either violent or non- violent videogames across all measurement sites, for each image category within the ELPP timeframe.

ELPP	Males (n=30)				Females (n=16)			
	Violent (n=13)		Nonviolent (n=17)		Violent (n=9)		Nonviolent (n=7)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	0.53	3.82	-1.42	2.11	-0.92	4.43	-3.43	2.11
Violent	0.06	4.76	-2.85	3.24	-0.31	5.31	-1.28	3.33
Erotic	-1.75	6.30	-3.12	4.87	-4.71	6.36	2.97	11.84
Disgust	-1.19	2.65	-3.71	4.97	-2.25	5.64	-2.33	6.60
Fcz								
Neutral	-0.41	3.40	-2.07	2.07	-1.96	3.38	-3.20	2.14
Violent	-0.46	4.88	-3.11	3.38	-1.41	4.16	-1.66	2.40
Erotic	-1.97	5.74	-3.05	4.31	-4.45	4.76	1.86	9.29
Disgust	-1.36	2.94	-3.51	4.19	-2.68	5.19	-2.63	4.37
Cz								
Neutral	0.57	2.75	-1.33	2.47	0.12	1.89	-0.59	1.98
Violent	-0.05	3.19	-1.75	2.62	2.09	5.56	0.29	2.10
Erotic	0.17	2.30	0.26	3.41	0.48	3.50	0.66	4.25
Disgust	-0.79	2.68	-0.45	2.66	1.11	3.91	0.35	3.13
Pz								
Neutral	2.67	2.92	1.37	2.53	2.63	2.15	1.99	1.86
Violent	2.20	1.93	3.09	3.25	5.27	5.31	3.18	3.09
Erotic	4.01	2.73	4.94	3.41	3.78	3.21	1.13	6.13
Disgust	2.14	2.32	4.55	4.53	4.85	2.08	4.51	1.50

4.6.3.10 650 – 850ms Post Stimuli (LLPP)

Table 56. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who preferred to play either violent or non- violent videogames across all measurement sites, for each image category within the LLPP timeframe.

LLPP	Males (n=30)				Females (n=16)			
	Violent (n=13)		Nonviolent (n=17)		Violent (n=9)		Nonviolent (n=7)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	0.58	3.28	-1.08	3.00	0.18	3.41	-2.26	1.61
Violent	-0.02	4.24	-2.18	1.61	1.25	4.30	-0.22	4.07
Erotic	-1.56	2.94	-1.64	4.33	-3.76	6.10	2.95	11.92
Disgust	-1.26	2.09	-2.62	4.01	-1.08	1.99	-1.01	6.86
Fcz								
Neutral	-0.03	2.79	-1.40	2.62	-0.44	2.60	-2.06	1.99
Violent	-0.07	4.12	-2.06	1.60	0.27	3.57	-0.49	2.57
Erotic	-1.47	2.64	-1.51	3.58	-3.35	4.33	2.32	10.52
Disgust	-1.15	2.49	-2.46	3.27	-1.75	2.37	-1.46	4.52
Cz								
Neutral	1.12	1.98	-0.63	1.89	0.65	1.10	-0.38	1.95
Violent	0.69	2.79	-0.84	1.48	2.22	5.59	0.29	1.06
Erotic	0.22	1.44	0.88	2.30	0.33	2.53	-0.30	4.45
Disgust	0.18	2.15	0.24	1.62	1.19	2.74	0.66	3.16
Pz								
Neutral	2.52	3.15	1.04	2.11	1.39	1.81	1.62	1.41
Violent	1.77	1.88	2.08	2.63	4.09	5.21	2.29	3.03
Erotic	2.68	2.18	3.09	2.07	2.02	3.03	-0.62	3.78
Disgust	1.51	2.23	3.28	3.72	4.04	1.56	3.50	2.80

A visual representation of these results has been provided using ERP waveforms below (see Figure 82 - 105).

Violent

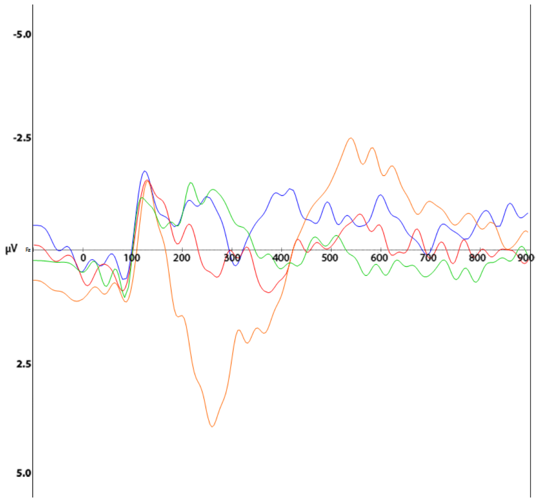


Figure 82. Grand average ERP waveform (microvolts) for those who prefer violent videogames at the Fz location, across time (milliseconds).

Non- Violent

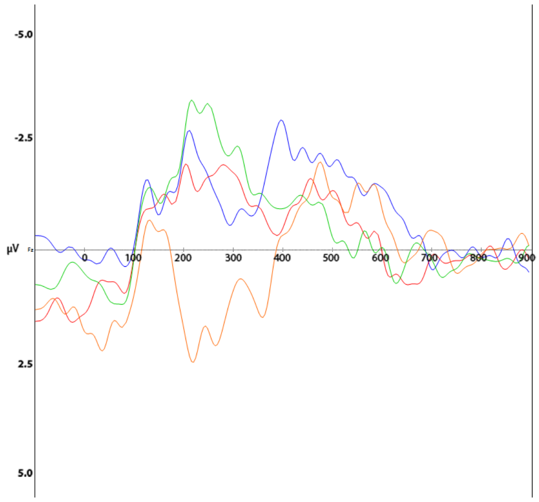


Figure 83. Grand average ERP waveform (microvolts) for those who prefer non-violent videogames at the Fz location, across time (milliseconds).

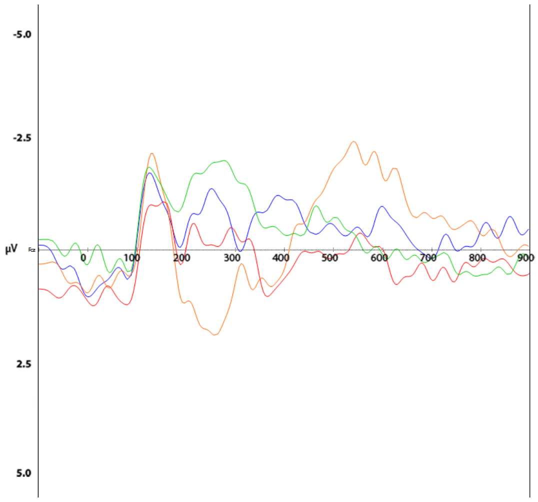


Figure 84. Grand average ERP waveform (microvolts) for those who prefer violent videogames at the Fcz location, across time (milliseconds).

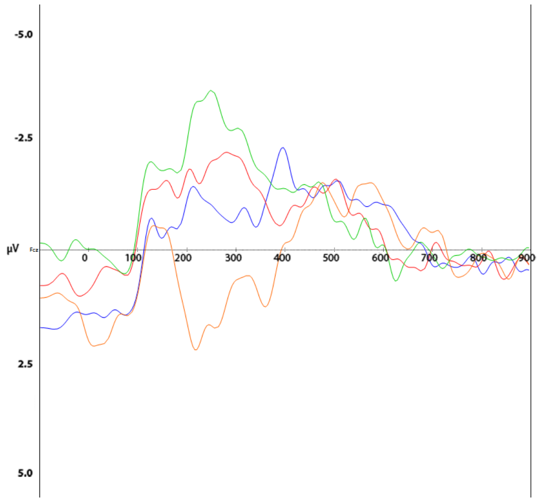


Figure 85. Grand average ERP waveform (microvolts) for those who prefer non-violent videogames at the Fcz location, across time (milliseconds).

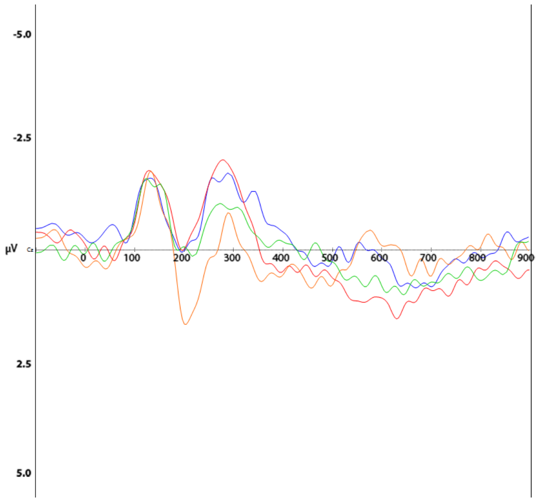


Figure 86 Grand average ERP waveform (microvolts) for those who prefer violent videogames at the Cz location, across time (milliseconds).

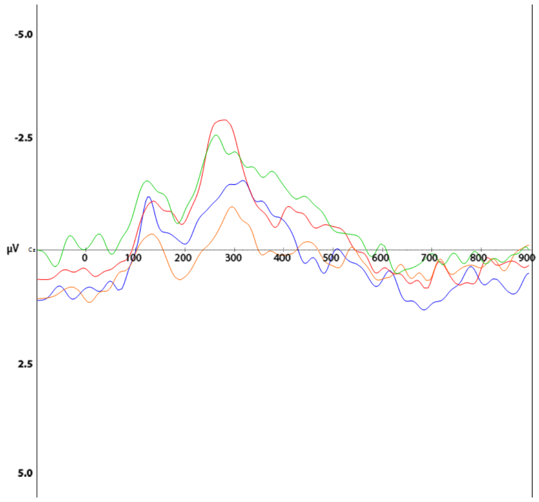


Figure 87. Grand average ERP waveform (microvolts) for those who prefer non-violent videogames at the Cz location, across time (milliseconds).

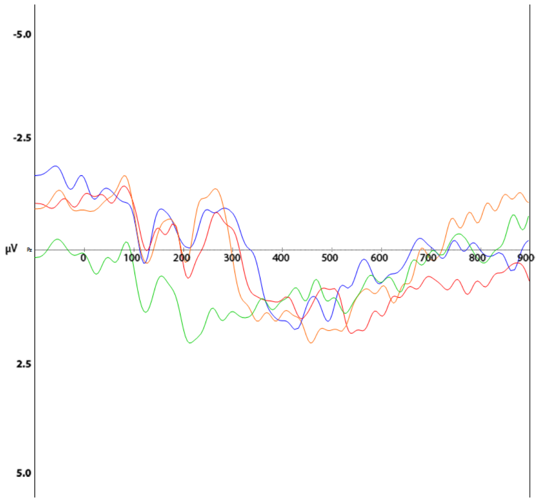


Figure 88 Grand average ERP waveform (microvolts) for those who prefer violent videogames at the Pz location, across time (milliseconds).

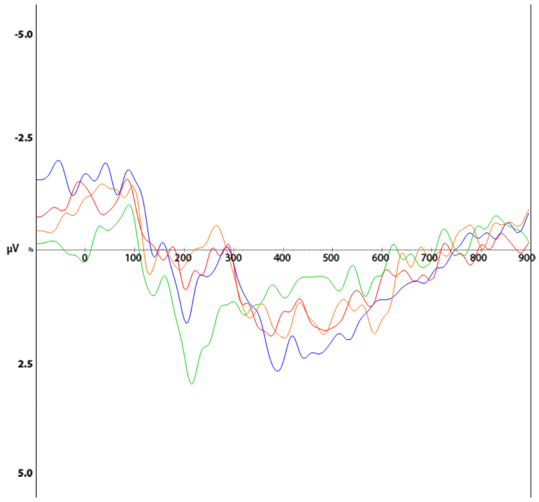


Figure 89. Grand average ERP waveform (microvolts) for those who prefer non-violent videogames at the Pz location, across time (milliseconds).

Males

Violent

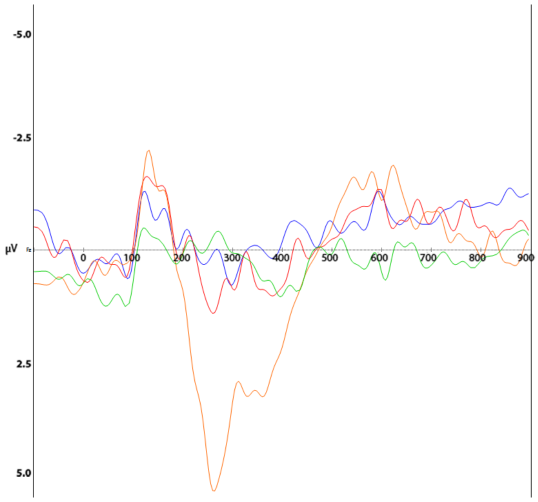


Figure 90. Grand average ERP waveform (microvolts) for males who prefer violent videogames at the Fz location, across time (milliseconds).

Non-Violent

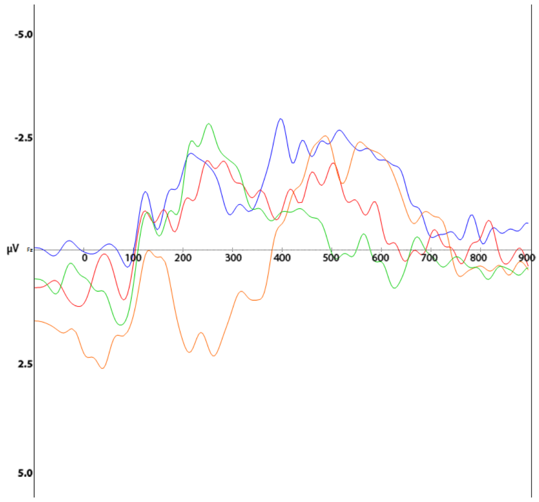


Figure 91. Grand average ERP waveform (microvolts) for males who prefer non-violent videogames at the Fz location, across time (milliseconds).

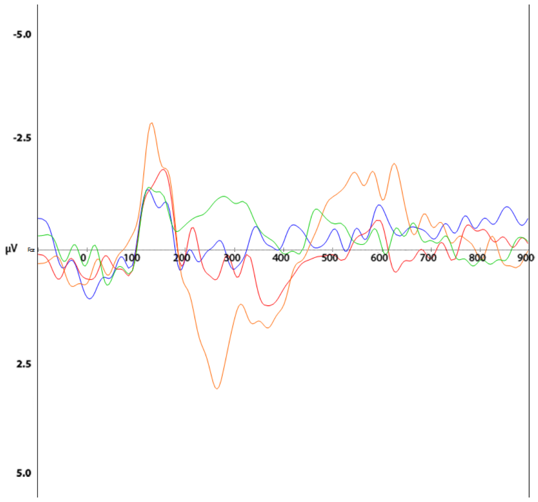


Figure 92. Grand average ERP waveform (microvolts) for males who prefer violent videogames at the Fcz location, across time (milliseconds).

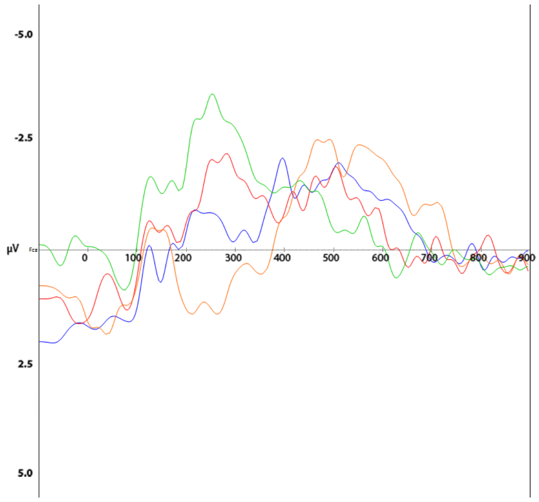


Figure 93. Grand average ERP waveform (microvolts) for males who prefer non-violent videogames at the Fcz location, across time (milliseconds).

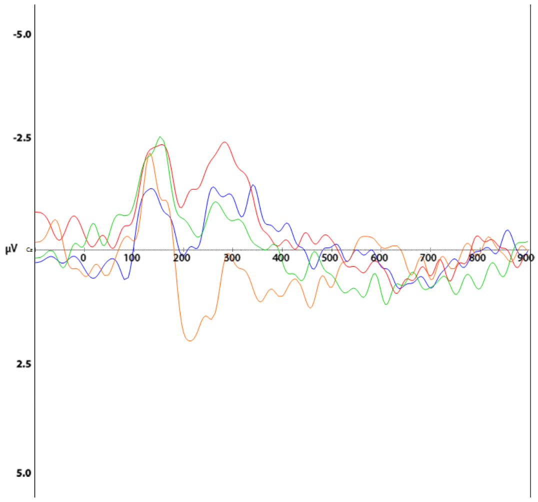


Figure 94. Grand average ERP waveform (microvolts) for males who prefer violent videogames at the Cz location, across time (milliseconds).

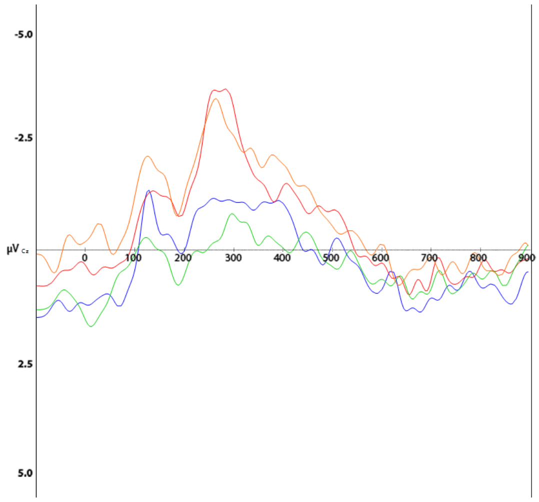


Figure 95. Grand average ERP waveform (microvolts) for males who prefer non-violent videogames at the Cz location, across time (milliseconds).

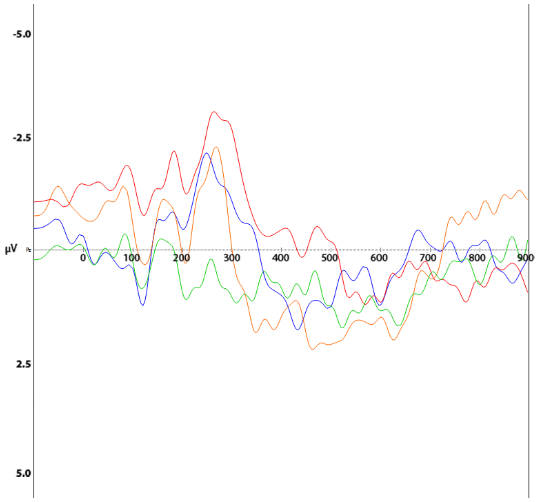


Figure 96. Grand average ERP waveform (microvolts) for males who prefer violent videogames at the Pz location, across time (milliseconds).

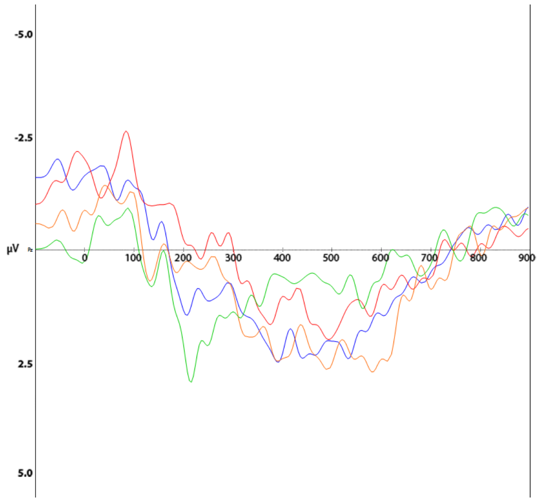


Figure 97. Grand average ERP waveform (microvolts) for males who prefer non-violent videogames at the Pz location, across time (milliseconds).

Neutral
Violent
Erotic
Disgust

Females

Violent

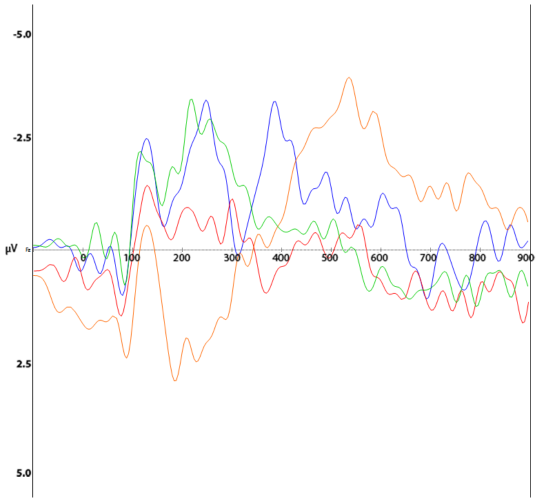


Figure 98. Grand average ERP waveform (microvolts) for females who prefer violent videogames at the Fz location, across time (milliseconds).

Non-Violent

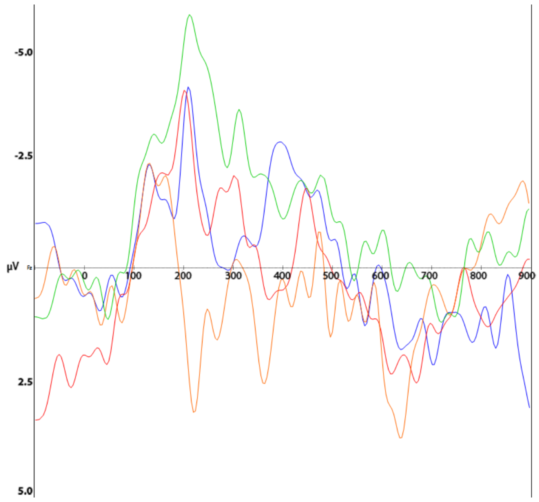


Figure 99. Grand average ERP waveform (microvolts) for females who prefer non-violent videogames at the Fz location, across time (milliseconds).

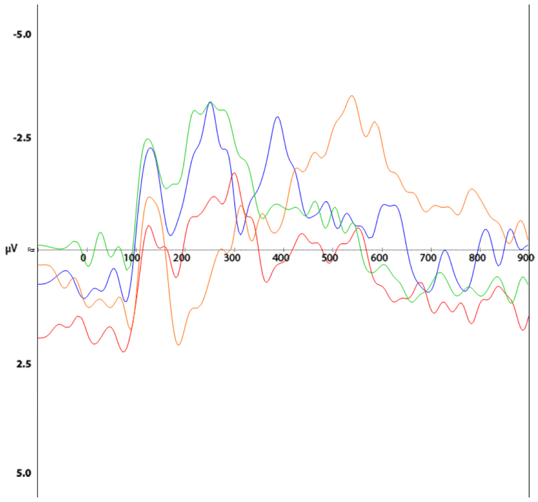


Figure 100. Grand average ERP waveform (microvolts) for females who prefer violent videogames at the Fcz location, across time (milliseconds).

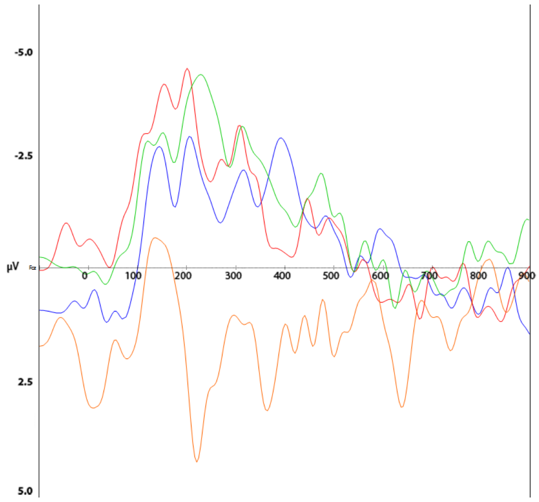


Figure 101. Grand average ERP waveform (microvolts) for females who prefer non-violent videogames at the Fcz location, across time (milliseconds).

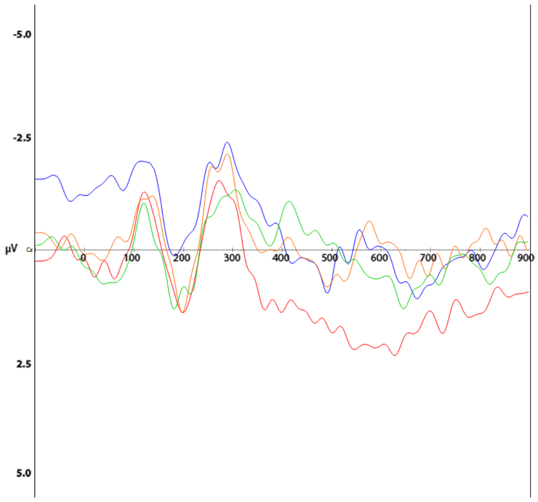


Figure 102. Grand average ERP waveform (microvolts) for females who prefer violent videogames at the Cz location, across time (milliseconds).

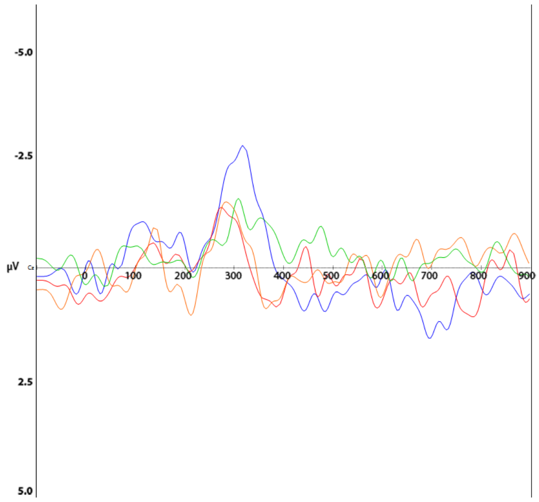


Figure 103. Grand average ERP waveform (microvolts) for females who prefer non-violent videogames at the Cz location, across time (milliseconds).

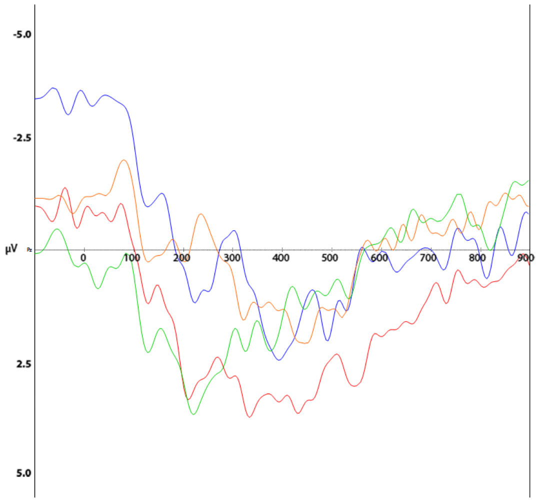


Figure 104. Grand average ERP waveform (microvolts) for females who prefer violent videogames at the Pz location, across time (milliseconds).

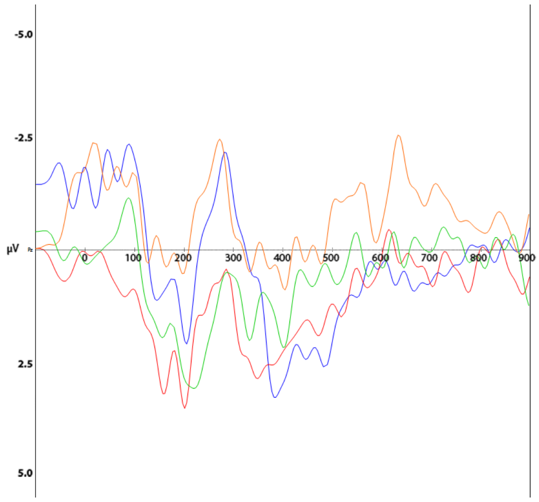


Figure 105. Grand average ERP waveform (microvolts) for females who prefer non-violent videogames at the Pz location, across time (milliseconds).

Table 57. Significant main and interaction effects across electrode and epoch on grand mean ERP amplitudes in response towards the four image categories.

Site	Epoch	Effect			
		Sex	Image	Preference towards VVG /NVVG	Interactions
Fz	100ms				Sex x Image $F(3, 42) = 7.32$, $p<0.001$, $\eta p2=.15$
	200ms		$F(3, 42) = 7.32$, $p<0.001$, $\eta p2=.51$		Sex x Image $F(3, 42) = 6.87$, $p<0.001$, $\eta p2=.14$ VVG x Image $F(3, 42) = 2.97$, $p=0.03$, $\eta p2=.06$
	300ms				
	ELPP				VVG x Image $F(3, 42) = 6.60$, $p<0.01$, $\eta p2=.14$ Sex x VVG x Image $F(3, 42) = 4.37$, $p<0.01$, $\eta p2=.09$
	LLPP				
Fcz	100ms				Sex x Image

					$F(3, 42)= 6.61$, $p<0.01$, $\eta p2=.14$ VVG x Image $F(3, 42)= 3.72$, $p=0.01$, $\eta p2=.08$
	200ms		$F(3, 42)= 38.99$, $p<0.001$, $\eta p2=.48$		Sex x Image $F(3, 42)= 4.29$, $p<0.01$, $\eta p2=.09$
	300ms		$F(3, 42)= 17.20$, $p<0.001$, $\eta p2=.29$		VVG x Image $F(3, 42)= 3.69$, $p=0.01$, $\eta p2=.08$
	ELPP				
	LLPP				
Cz	100ms	$F(1, 42)= 6.48$, $p=0.01$, $\eta p2=.13$			Sex x Image $F(3, 42)= 4.26$, $p<0.01$, $\eta p2=.09$
	200ms		$F(3, 42)= 7.56$, $p<0.001$, $\eta p2=.15$		Sex x Image $F(3, 42)= 4.97$, $p<0.01$, $\eta p2=.11$
	300ms				
	ELPP				
	LLPP				

Pz	100ms	F(1, 42)= 4.01, p=0.05, ηp2=.09			
	200ms	F(1, 42)= 8.04, p<0.01, ηp2=.16	F(1, 42)= 20.88, p<0.01, ηp2=.33		
	300ms				Sex x Image F(3, 42)= 4.11, p<0.01, ηp2=.09
	ELPP		F(3, 42)= 3.66, p=0.01, ηp2=.08		
	LLPP				Sex x Image F(3, 42)= 4.32, p<0.01, ηp2=.09

Table 58. Significant p-values from independent T-tests for the effect of sex, across site and epoch (adjusted alpha value =0.025).

	Epoch				
Region and Image Category	100	200	300	ELPP	LLPP
Fz					
Violent					
Erotic					

Disgust					
Neutral					
Fcz					
Violent					
Erotic					
Disgust					
Neutral					
Cz					
Violent					
Erotic					
Disgust					
Neutral					
Pz					
Violent	$t=-2.63$, $df=44$, $p=0.01$, $d=0.86$	$t=-3.31$, $df=44$, $p<0.01$, $d=0.98$			
Erotic					
Disgust					
Neutral	$t=-2.70$, $df=44$, $p=0.01$, $d=0.87$	$t=-3.43$, $df=44$, $p<0.01$, $d=1.02$			

Table 59. Significant P–values for pairwise comparisons across the effect of image across site and epoch.

Site	Epoch	Effect		
		Image	Difference Between Groups	P-value*
Fz	200ms	F(3, 42)= 7.32, p<0.001, ηp2=.51	Violent – Erotic	<0.01, d=0.87
			Violent – Neutral	<0.01, d=0.21
			Erotic – Disgust	<0.01, d=0.86
			Erotic - Neutral	<0.01, d=0.86
Fcz	200ms	F(3, 42)= 38.99, p<0.001, ηp2=.48	Violent – Erotic	<0.01, d=0.90
			Erotic – Disgust	<0.01, d=0.85
			Erotic - Neutral	<0.01, d=1.03
			Disgust - Neutral	<0.01, d=0.22
	300ms	F(3, 42)= 17.20, p<0.001, ηp2=.29	Violent - Erotic	<0.01, d=0.51
			Erotic – Disgust	<0.01, d=0.68
			Erotic - Neutral	<0.01, d=0.76
Cz	200ms	F(3, 42)= 7.56, p<0.001, ηp2=.15	Violent - Erotic	<0.01, d=0.60
Pz	200ms	F(1, 42)= 20.88, p<0.01, ηp2=.33	Violent - Neutral	=0.01, d=0.37
			Erotic - Neutral	<0.01, d=0.55
	ELPP	F(3, 42)= 3.66, p=0.01, ηp2=.08	Disgust – Neutral	=0.02, d=0.63

*Values adjusted for multiple comparisons using Bonferroni correction

There were no main effects found dependant on whether participants preferred playing violent or non-violent videogames. However, there were several effects analysed showing interactions between sex x image and previous preference towards violent/non-violent videogames x image (see Table 57-59.). There were no constant patterns found across either variable but, it was shown that ERP amplitude was inconsistent across sex and the preferences to play violent or non-violent videogame variable. Main effects of sex showed that there were differences based on sex across the images in early epochs recorded over central and parietal regions. Additionally, there were consistent main effects of image found across all recording sites especially for the 200ms epoch. However, there were no consistency found between categories (i.e. violent and neutral). Overall, this has suggested that both sex and image stimuli influence erp response across epoch and measurement site.

4.6.4 Section 4: Sex x Preference Towards Watching Violent or Non-Violent Films x Image

This is the analysis of sex differences, whether participants preferred watching violent or non-violent films by location and epoch in response to affective images. Means and standard deviations have been provided in the below sequence of tables (see Table 60 – 69.). The data was analysed using mixed ANOVA (Sex, 2 levels: Male and Female x Preference towards watching violent or non-violent films, 2 levels; Violent and Non-Violent x Image, 4 levels: Neutral, Violent, Disgust and Erotic). Bonferroni adjusted post-hoc tests for more than two comparisons (e.g. image) and independent t-test (with alpha adjusted to .025) for sex were conducted. Only significant results have been provided below.

4.6.4.1 50 – 150ms Post Stimuli (100ms)

Table 60. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who prefer to watch either violent or non-violent films across all measurement sites, for each image category within the 100ms timeframe.

100ms	Violent (n=36)		Non-Violent (n=27)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-1.07	1.88	-0.29	2.10

Violent	-1.66	2.00	-1.14	1.32
Erotic	-1.58	2.63	-0.90	2.13
Disgust	-1.04	1.88	-0.78	1.53
Fcz				
Neutral	-1.45	1.58	-0.74	1.47
Violent	-1.90	1.73	-1.26	1.17
Erotic	-1.77	2.19	-0.95	1.79
Disgust	-1.44	1.73	-1.03	1.28
Cz				
Neutral	-1.39	1.43	-1.59	1.31
Violent	-1.62	1.34	-1.37	1.35
Erotic	-1.49	1.04	-0.97	1.04
Disgust	-1.29	1.50	-1.21	0.90
Pz				
Neutral	0.37	2.27	-0.56	2.31
Violent	0.20	2.31	-0.26	1.84
Erotic	0.06	2.17	0.46	1.57
Disgust	0.82	2.51	0.07	2.01

4.6.4.2 150 – 250ms Post Stimuli (200ms)

Table 61. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who prefer to watch either violent or non-violent films across all measurement sites, for each image category within the 200ms timeframe.

200ms	Violent (n=36)		Non-Violent (n=27)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-2.70	3.97	-2.59	2.61
Violent	-1.88	4.33	-1.65	3.15
Erotic	0.77	4.90	0.55	3.62
Disgust	-1.82	3.68	-1.99	3.11
Fcz				

Neutral	-2.81	3.31	-2.76	2.29
Violent	-2.27	3.65	-2.13	3.11
Erotic	0.14	4.17	0.01	3.01
Disgust	-2.03	3.35	-2.06	2.93
Cz				
Neutral	-0.81	2.23	-1.79	2.82
Violent	-1.53	2.47	-2.17	3.83
Erotic	-0.09	2.45	-0.27	2.65
Disgust	-0.85	2.76	-1.25	2.59
Pz				
Neutral	2.59	2.86	1.25	3.34
Violent	1.41	3.49	0.53	2.55
Erotic	0.86	3.17	1.29	2.31
Disgust	2.27	3.00	0.75	3.55

4.6.4.3 250 – 450ms Post Stimuli (300ms)

Table 62. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who prefer to watch either violent or non-violent films across all measurement sites, for each image category within the 300ms timeframe.

300ms	Violent (n=36)		Non-Violent (n=27)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-1.29	3.76	-1.89	2.51
Violent	0.01	4.88	-1.11	5.05
Erotic	1.15	4.40	-0.22	3.85
Disgust	-1.60	4.02	-1.68	3.07
Fcz				
Neutral	-2.08	3.15	-2.55	2.38
Violent	-0.93	4.37	-2.13	4.63
Erotic	0.18	3.78	-1.08	2.98
Disgust	-2.25	3.50	-2.13	2.87

Cz				
Neutral	-1.88	2.64	-2.18	2.62
Violent	-1.72	3.38	-2.42	3.25
Erotic	-0.25	2.97	-0.79	2.22
Disgust	-1.44	3.04	-1.46	2.39
Pz				
Neutral	1.41	2.50	1.24	2.94
Violent	1.80	3.88	1.58	2.34
Erotic	2.59	3.59	2.95	2.91
Disgust	3.02	3.55	2.55	3.78

4.6.4.4 450 – 650ms Post Stimuli (ELPP)

Table 63. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who prefer to watch either violent or non-violent films across all measurement sites, for each image category within the ELPP timeframe.

ELPP	Violent (n=36)		Non-Violent (n=27)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-0.37	3.52	-1.31	2.80
Violent	0.28	4.16	-1.42	4.46
Erotic	-1.37	4.68	-4.31	5.49
Disgust	-1.39	4.00	-3.52	4.29
Fcz				
Neutral	-1.09	2.84	-1.77	2.63
Violent	-0.40	3.59	-2.15	4.02
Erotic	-1.45	3.71	-4.13	4.63
Disgust	-1.64	3.10	-3.30	3.77
Cz				
Neutral	-0.41	2.21	-0.96	2.24
Violent	-0.29	2.39	-1.07	2.76
Erotic	0.99	3.10	-0.21	2.52

Disgust	0.24	2.79	-0.19	2.54
Pz				
Neutral	1.88	2.35	1.52	2.78
Violent	2.68	2.78	2.08	2.19
Erotic	3.86	3.90	4.48	2.96
Disgust	3.62	3.17	3.70	3.53

4.6.4.5 650 – 850ms Post Stimuli (LLPP)

Table 64. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for participants who prefer to watch either violent or non-violent films across all measurement sites, for each image category within the LLPP timeframe.

LLPP	Violent (n=36)		Non-Violent (n=27)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	0.24	2.98	-0.64	3.04
Violent	0.77	3.39	-0.90	3.45
Erotic	-1.94	4.89	-2.43	3.23
Disgust	-1.18	4.13	-2.97	3.39
Fcz				
Neutral	-0.22	2.40	-0.97	2.78
Violent	0.25	2.77	-1.25	2.98
Erotic	-1.75	3.84	-2.28	2.50
Disgust	-1.28	3.09	-2.68	2.94
Cz				
Neutral	0.23	1.59	-0.15	1.89
Violent	0.11	2.03	-0.11	2.03
Erotic	0.61	2.79	0.61	1.43
Disgust	0.63	2.32	0.50	1.86
Pz				
Neutral	1.47	2.11	1.34	2.52
Violent	1.82	2.45	1.71	1.70

Erotic	2.35	2.79	3.05	2.19
Disgust	2.83	3.07	2.80	2.47

4.6.4.6 50 – 150ms Post Stimuli (100ms)

Table 65. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who prefer to watch either violent or non- violent films across all measurement sites, for each image category within the 100ms timeframe.

100ms	Males (n=28)				Females (n= 32)			
	Violent (n=17)		NonViolent (n=14)		Violent (n=19)		NonViolent (n=13)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.01	1.84	0.55	2.29	-1.12	1.97	-1.21	1.46
Violent	-1.42	1.93	-1.19	0.88	-1.89	2.08	-1.10	1.71
Erotic	-2.14	2.09	-0.90	2.55	-1.08	2.99	-0.89	1.68
Disgust	-0.51	1.67	-0.34	1.05	-1.51	1.97	-1.26	1.84
Fcz								
Neutral	-1.51	1.43	-0.18	1.49	-1.40	1.74	-1.34	1.23
Violent	-1.59	1.60	-1.42	1.07	-2.18	1.83	-1.08	1.29
Erotic	-2.16	1.92	-0.96	2.16	-1.42	2.41	-0.95	1.37
Disgust	-1.05	1.69	-0.84	0.87	-1.79	1.73	-1.24	1.63
Cz								
Neutral	-1.83	1.49	-2.05	1.25	-1.00	1.29	-1.09	1.23
Violent	-1.63	1.48	-1.97	1.43	-1.61	1.25	-0.72	0.93
Erotic	-1.75	0.96	-1.32	1.12	-1.26	1.08	-0.60	0.82
Disgust	-1.35	1.67	-1.38	0.86	-1.24	1.36	-1.02	0.94
Pz								
Neutral	0.03	2.65	-1.43	2.47	0.68	1.88	0.37	1.77
Violent	-0.40	2.93	-0.93	1.86	0.74	1.43	0.47	1.58
Erotic	-0.34	1.37	-0.22	1.73	0.42	2.68	1.20	1.01

Disgust	0.76	3.01	-0.30	2.22	0.86	2.05	0.47	1.77

4.6.4.7 150 – 250ms Post Stimuli (200ms)

Table 66. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who prefer to watch either violent or non- violent films across all measurement sites, for each image category within the 200ms timeframe.

200ms	Males (n=28)				Females (n= 32)			
	Violent (n=17)		NonViolent (n=14)		Violent (n=19)		NonViolent (n=13)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.96	4.11	-1.76	2.15	-3.37	3.82	-3.47	2.83
Violent	-1.29	4.51	-1.47	3.60	-2.41	4.21	-1.85	2.71
Erotic	0.91	4.92	1.17	3.48	0.64	5.01	-0.13	3.79
Disgust	-1.07	4.42	-1.33	3.18	-2.49	2.82	-2.70	2.98
Fcz								
Neutral	-2.31	3.40	-2.41	2.14	-3.25	3.26	-3.14	2.47
Violent	-1.59	4.12	-2.25	3.81	-2.88	3.15	-2.00	2.26
Erotic	0.47	4.61	0.56	3.08	-0.15	3.83	-0.57	2.93
Disgust	-1.43	4.11	-1.83	3.15	-2.58	2.47	-2.31	2.78
Cz								
Neutral	-1.28	2.69	-2.76	3.31	-0.39	1.67	-0.76	1.77
Violent	-2.22	3.08	-3.60	4.69	-0.92	1.59	-0.62	1.71
Erotic	0.06	3.01	-0.37	3.37	-0.23	1.89	-0.16	1.69
Disgust	-1.13	3.69	-1.74	3.37	-0.60	1.59	-0.73	1.29
Pz								
Neutral	1.81	2.48	0.11	2.83	3.29	3.05	2.48	3.51
Violent	-0.25	3.31	-1.04	2.13	2.89	3.00	2.22	1.81
Erotic	-0.18	2.33	0.42	2.76	1.79	3.58	2.22	1.24
Disgust	1.64	2.95	-0.24	3.37	2.83	3.01	1.81	3.55

4.6.4.8 250 – 450ms Post Stimuli (300ms)

Table 67. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who prefer to watch either violent or non- violent films across all measurement sites, for each image category within the 300ms timeframe.

300ms	Males (n=28)				Females (n= 32)			
	Violent (n=17)		NonViolent (n=14)		Violent (n=19)		NonViolent (n=13)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-0.82	3.82	-1.82	2.27	-1.70	3.76	-1.96	2.84
Violent	0.67	4.71	-2.04	6.12	-0.58	5.08	-0.11	3.56
Erotic	2.72	3.48	-0.63	3.40	-0.25	4.74	0.23	4.39
Disgust	-0.69	3.21	-1.69	2.72	-2.41	4.55	-1.67	3.51
Fcz								
Neutral	-1.75	3.35	-2.69	2.37	-2.37	3.01	-2.41	2.47
Violent	-0.06	4.83	-3.12	5.67	-1.72	3.88	-1.07	3.06
Erotic	1.60	3.25	-1.42	2.46	-1.08	3.85	-0.71	3.52
Disgust	-1.44	3.05	-2.26	2.84	-2.98	3.79	-2.00	3.01
Cz								
Neutral	-2.07	3.58	-2.37	3.15	-1.71	1.45	-1.98	2.00
Violent	-2.27	4.39	-3.55	3.96	-1.23	2.12	-1.20	1.67
Erotic	0.22	3.28	-1.02	2.66	-0.67	2.68	-0.55	1.71
Disgust	-1.70	3.43	-1.91	3.02	-1.21	2.73	-0.98	1.40
Pz								
Neutral	0.59	2.92	1.13	2.56	2.15	1.82	1.34	3.40
Violent	0.18	4.23	0.91	2.13	3.25	2.95	2.31	2.41
Erotic	1.76	3.42	2.86	3.01	3.34	3.67	3.05	2.92
Disgust	2.07	4.03	2.52	3.59	3.86	2.91	2.59	4.12

4.6.4.9 450 – 650ms Post Stimuli (ELPP)

Table 68. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females who prefer to watch either violent or non- violent films across all measurement sites, for each image category within the ELPP timeframe.

ELPP	Males (n=28)				Females (n= 32)			
	Violent (n=17)		NonViolent (n=14)		Violent (n=19)		NonViolent (n=13)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	0.11	3.31	-1.71	2.66	-0.80	3.74	-0.88	3.00
Violent	0.18	3.98	-2.98	4.99	0.37	4.42	0.26	3.19
Erotic	0.05	3.60	-6.18	5.31	-2.65	5.24	-2.30	5.12
Disgust	-1.00	2.65	-4.42	5.14	-1.74	4.97	-2.54	3.06
Fcz								
Neutral	-0.83	2.83	-2.32	2.64	-1.32	2.91	-1.17	2.59
Violent	-0.11	3.89	-3.76	4.55	-0.66	3.38	-0.43	2.53
Erotic	-0.24	3.01	-5.99	4.70	-2.53	4.02	-2.13	3.76
Disgust	-1.29	2.25	-4.23	4.58	-1.95	3.74	-2.30	2.44
Cz								
Neutral	-0.30	2.90	-1.31	2.85	-0.50	1.41	-0.58	1.36
Violent	-0.28	3.02	-2.35	3.13	-0.30	1.73	0.31	1.38
Erotic	1.18	2.77	-1.53	2.30	0.82	3.44	1.20	1.94
Disgust	-0.29	2.53	-1.36	2.52	0.70	3.00	1.06	1.96
Pz								
Neutral	1.62	2.80	1.64	3.12	2.11	1.90	1.39	2.50
Violent	2.68	3.39	2.04	2.64	2.67	2.18	2.12	1.67
Erotic	3.83	3.13	4.97	3.22	3.88	4.56	3.95	2.68
Disgust	2.78	3.66	3.96	4.00	4.38	2.53	3.42	3.07

4.6.4.10 650 – 850ms Post Stimuli (LLPP)

Table 69. Means and standard deviations of EEG amplitudes, measured in

microvolt's (uV), for males and females who prefer to watch either violent or non- violent films across all measurement sites, for each image category within the LLPP timeframe.

LLPP	Males (n=28)				Females (n= 32)			
	Violent (n=17)		NonViolent (n=14)		Violent (n=19)		NonViolent (n=13)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	0.66	3.03	-0.84	3.33	-0.80	3.74	-0.88	3.00
Violent	-0.12	3.00	-1.78	4.06	0.37	4.42	0.26	3.19
Erotic	-1.23	4.21	-2.48	3.08	-2.65	5.24	-2.30	5.12
Disgust	-0.73	2.72	-3.22	3.80	-1.74	4.97	-2.54	3.06
Fcz								
Neutral	0.02	2.39	-1.26	3.10	-1.32	2.91	-1.17	2.59
Violent	-0.09	2.84	-2.14	3.54	-0.66	3.38	-0.43	2.53
Erotic	-1.04	3.55	-2.52	2.36	-2.53	4.02	-2.13	3.76
Disgust	-0.84	2.38	-3.01	3.30	-1.95	3.74	-2.30	2.44
Cz								
Neutral	0.58	1.88	-0.46	2.36	-0.50	1.41	-0.58	1.36
Violent	0.11	2.19	-1.02	2.39	-0.30	1.73	0.31	1.38
Erotic	0.76	2.45	-0.09	1.06	0.82	3.44	1.20	1.94
Disgust	0.26	1.82	-0.13	1.79	0.70	3.00	1.06	1.96
Pz								
Neutral	1.51	2.61	1.25	3.18	2.11	1.90	1.39	2.50
Violent	1.83	2.64	1.47	2.07	2.67	2.18	2.12	1.67
Erotic	2.32	1.95	3.15	2.42	3.88	4.56	3.95	2.68
Disgust	1.85	3.35	2.73	2.85	4.38	2.53	3.42	3.07

A visual representation of these results have been provided using ERP waveforms below (see Figure 106 - 125).

Violent

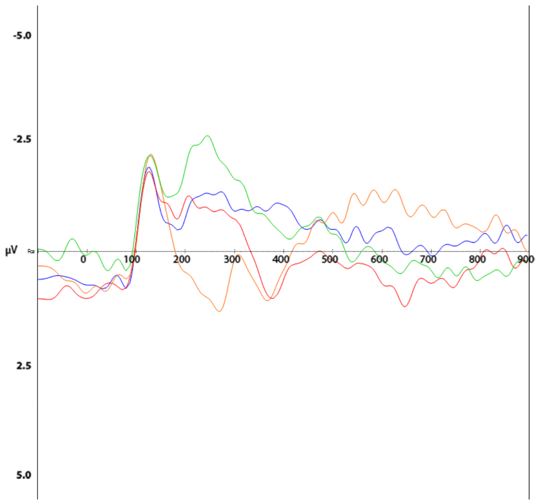


Figure 106. Grand average ERP waveform (microvolts) for participants who prefer to watch violent films at the Fcz location, across time (milliseconds).

Non- Violent

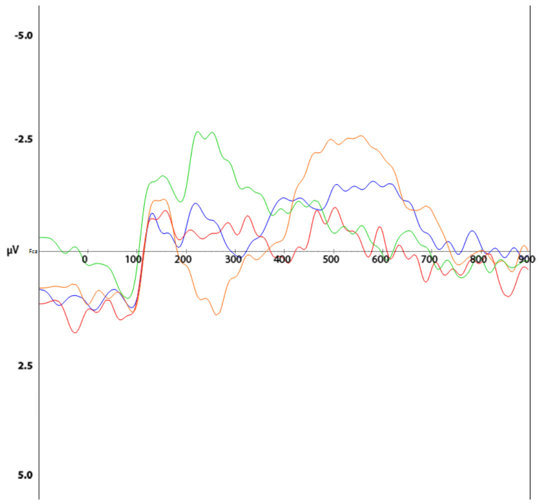


Figure 107. Grand average ERP waveform (microvolts) for participants who prefer to watch non-violent films at the Fcz location, across time (milliseconds).

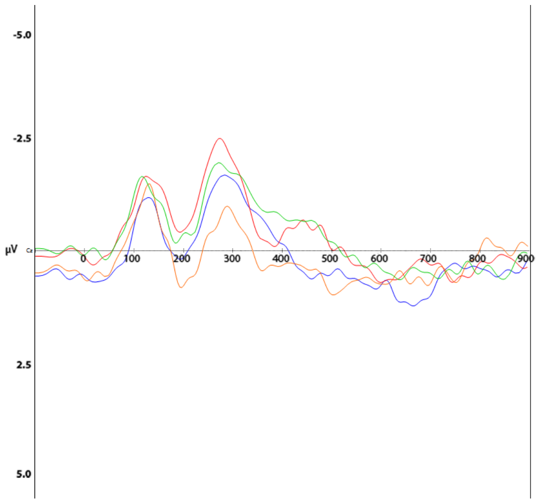


Figure 108. Grand average ERP waveform (microvolts) for participants who prefer to watch violent films at the Cz location, across time (milliseconds).

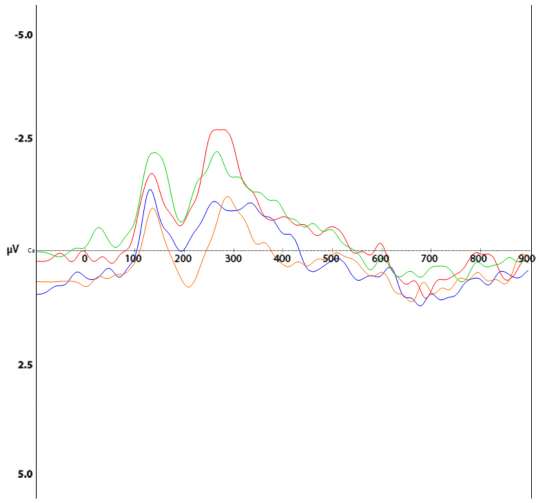


Figure 109. Grand average ERP waveform (microvolts) for participants who prefer to watch non-violent films at the Cz location, across time (milliseconds).

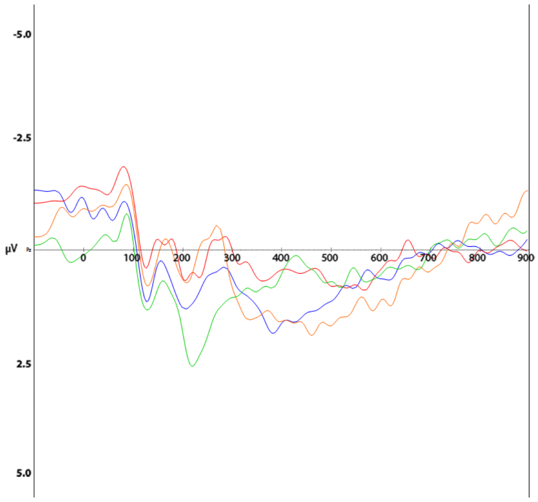


Figure 110. Grand average ERP waveform (microvolts) for participants who prefer to watch violent films at the Pz location, across time (milliseconds).

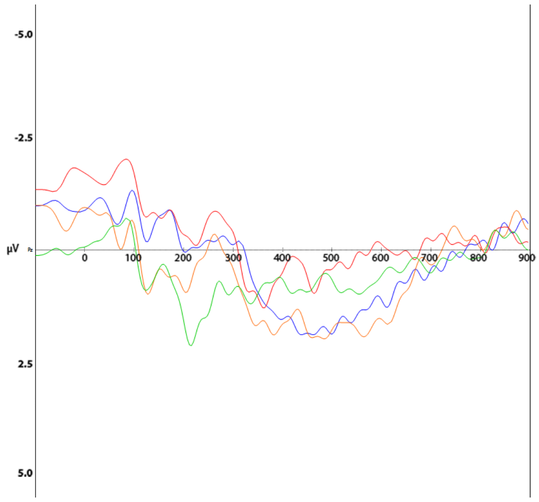


Figure 111. Grand average ERP waveform (microvolts) for participants who prefer to watch non-violent films at the Pz location, across time (milliseconds).

Males

Violent

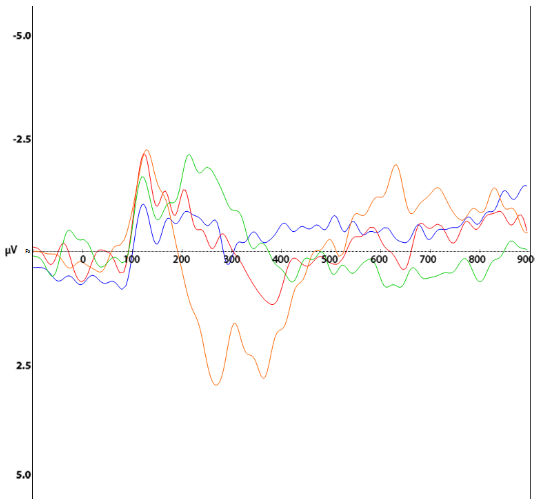


Figure 112. Grand average ERP waveform (microvolts) for males who prefer watching violent films over the Fz location, across time (milliseconds).

Non-Violent

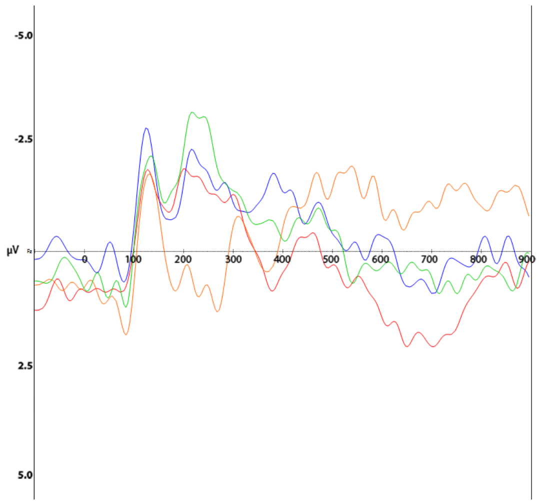


Figure 113. Grand average ERP waveform (microvolts) for males who prefer watching non-violent films over the Fz location, across time (milliseconds).

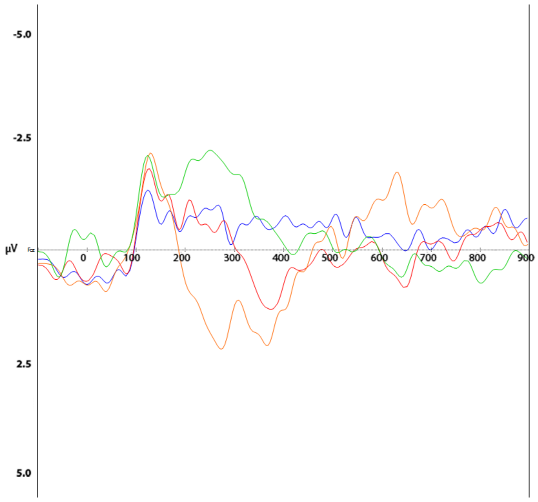


Figure 114. Grand average ERP waveform (microvolts) for males who prefer watching violent films over the Fcz location, across time (milliseconds).

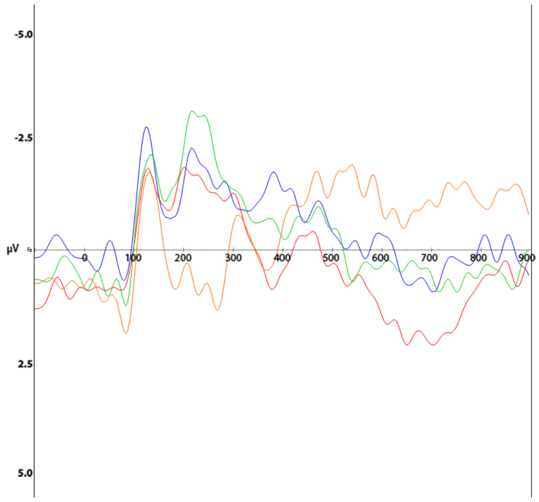


Figure 115. Grand average ERP waveform (microvolts) for males who prefer watching non-violent films over the Fcz location, across time (milliseconds).

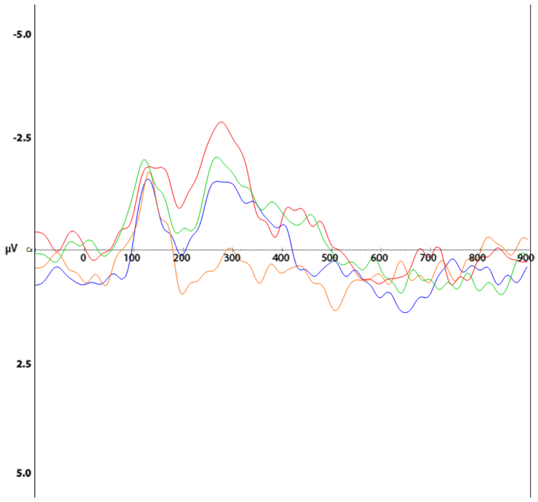


Figure 116. Grand average ERP waveform (microvolts) for males who prefer watching violent films over the Cz location, across time (milliseconds).

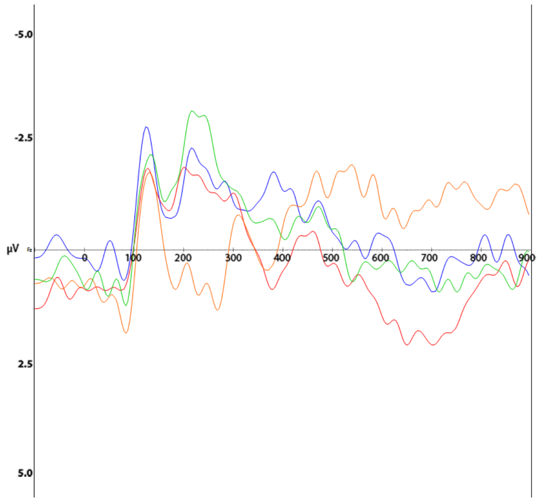


Figure 117. Grand average ERP waveform (microvolts) for males who prefer watching non-violent films over the Cz location, across time (milliseconds).

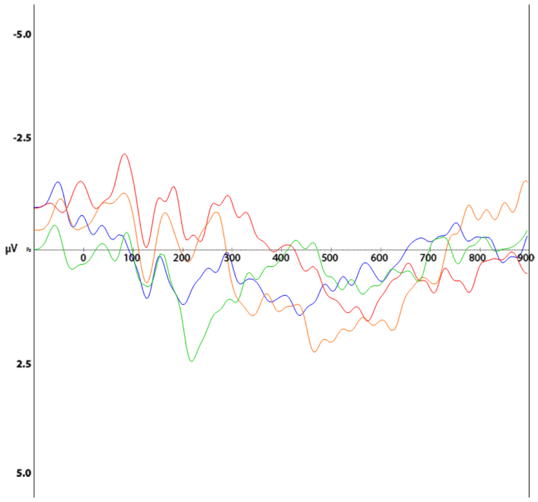


Figure 118. Grand average ERP waveform (microvolts) for males who prefer watching violent films over the Pz location, across time (milliseconds).

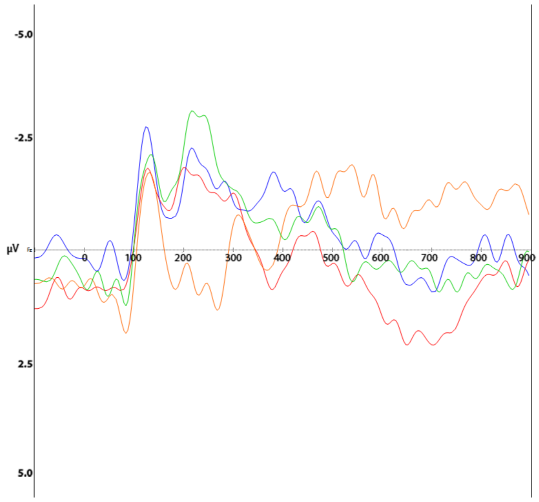


Figure 119. Grand average ERP waveform (microvolts) for males who prefer watching non-violent films over the Pz location, across time (milliseconds).

Females

<u>Violent</u>

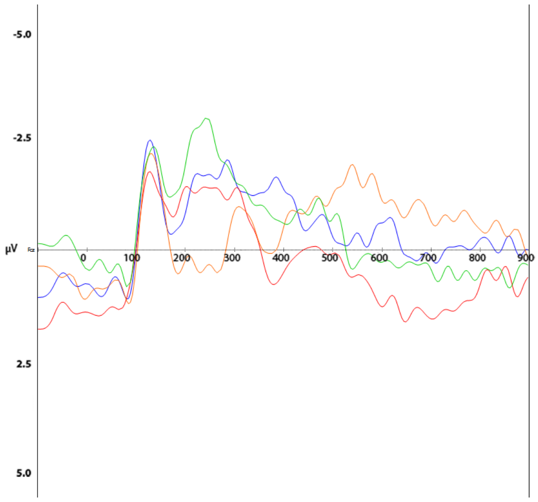


Figure 120. Grand average ERP waveform (microvolts) for females who prefer watching violent films over the Fcz location, across time (milliseconds).

<u>Non-Violent</u>

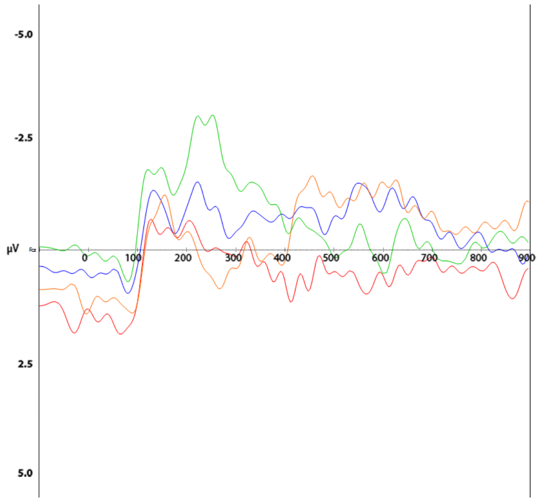


Figure 121. Grand average ERP waveform (microvolts) for females who prefer watching non-violent films over the Fcz location, across time (milliseconds).

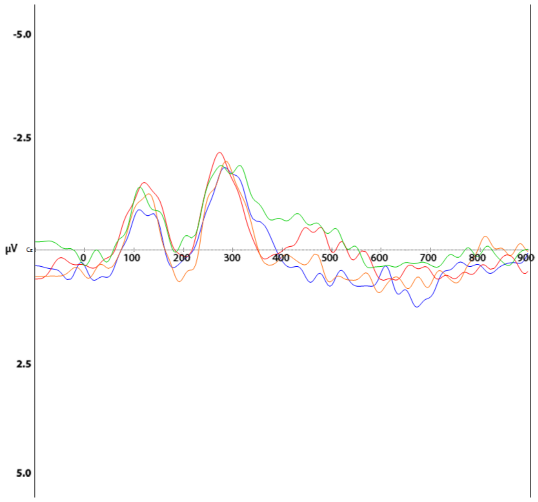


Figure 122. Grand average ERP waveform (microvolts) for females who prefer watching violent films over the Cz location, across time (milliseconds).

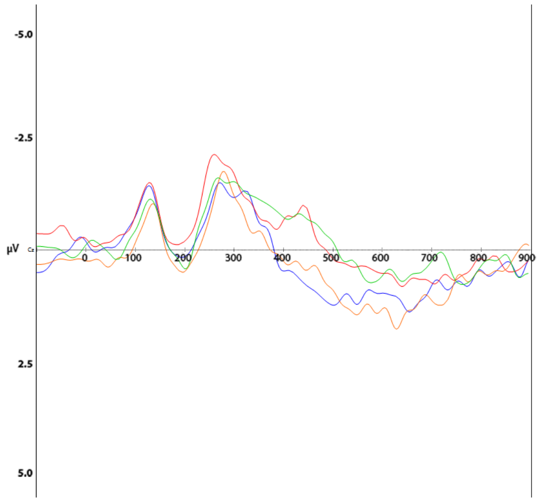


Figure 123. Grand average ERP waveform (microvolts) for females who prefer watching non-violent films over the Cz location, across time (milliseconds).

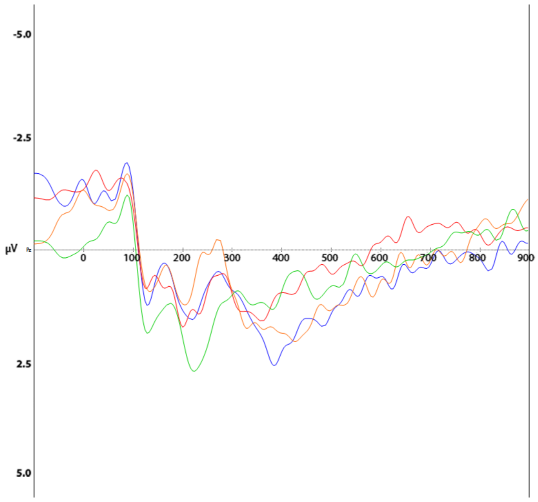


Figure 124. Grand average ERP waveform (microvolts) for females who prefer watching violent films over the Pz location, across time (milliseconds).

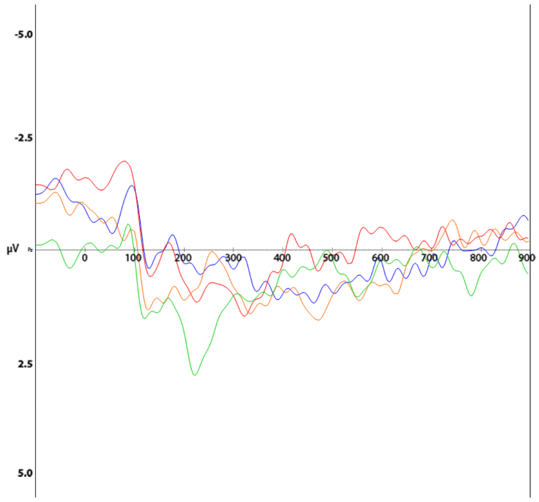


Figure 125. Grand average ERP waveform (microvolts) for females who prefer watching non-violent films over the Pz location, across time (milliseconds).

Table 70. Significant main and interaction effects across electrode and epoch on grand mean ERP amplitudes in response towards the four image categories.

Site	Epoch	Effect			
		Sex	Image	Preference towards Violent/Nonviolent Film	Interactions
Fz	100ms		F(3, 59)= 3.18, p=0.03, ηp2=.05		Sex x Image F(3, 59)= 3.93, p=0.01, ηp2=.06
	200ms		F(3, 59)= 24.38, p<0.001, ηp2=.29		
	300ms		F(3, 59)= 18.38, p<0.001, ηp2=.20	F(1, 59)= 3.18, p=0.03, ηp2=.06	
	ELPP		F(3, 59)= 11.01, p<0.001, ηp2=.16	F(1, 59)= 4.67, p=0.04, ηp2=.07	
	LLPP		F(3, 59)= 12.05, p<0.001, ηp2=.17		
Fcz	100ms				
	200ms		F(3, 59)= 25.85, p<0.001, ηp2=.31	F(1, 59)= 4.02, p=0.02, ηp2=.06	
	300ms		F(3, 59)= 10.77, p<0.001, ηp2=.13		
	ELPP	F(1, 59)= 6.41, p=0.04, ηp2=.12	F(3, 59)= 7.42, p<0.001, ηp2=.11	F(1, 59)= 5.08, p=0.03, ηp2=.08	Sex x Image x Film F(3, 59)= 3.22, p=0.02, ηp2=.05

	LLPP		F(3, 59)= 10.07, p<0.001, ηp2=.15		
Cz	100ms	F(1, 59)= 5.86, p=0.01, ηp2=.09			
	200ms	F(1, 59)= 4.01, p=0.01, ηp2=.10	F(3, 59)= 24.38, p<0.001, ηp2=.20		Sex x Image F(3, 59)= 6.67, p<0.01, ηp2=.10
	300ms		F(3, 59)= 5.52, p<0.001, ηp2=.07		
	ELPP	F(1, 59)= 4.65, p=0.03, ηp2=.07	F(3, 59)= 6.14, p<0.001, ηp2=.09		
	LLPP				
Pz	100ms	F(1, 59)= 5.92, p=0.01, ηp2=.09			
	200ms	F(1, 59)= 12.26, p<0.001, ηp2=.18	F(3, 59)= 3.58, p=0.02, ηp2=.06		Film x Image F(3, 59)= 3.51, p=0.02, ηp2=.06
	300ms		F(3, 59)= 2.70, p=0.05, ηp2=.04		Sex x Image F(3, 59)= 3.08, p=0.03, ηp2=.05
	ELPP				
	LLPP		F(3, 59)= 5.69, p<0.001, ηp2=.09		

Table 71. Significant p-values from independent T-tests for the effect of sex, across site and epoch (adjusted alpha value =0.025).

	Epoch				
Region and Image Category	100	200	300	ELPP	LLPP
Fz					
Violent					
Erotic					
Disgust					
Neutral					
Fcz					
Violent					
Erotic					
Disgust					
Neutral					
Cz					
Violent		$t=-2.75$, $df=61$, $p<0.01$, $d=0.20$			
Erotic					

Disgust			t=-2.50, df=61, p=0.02, d=0.32		
Neutral	t=-2.71, df=61, p<0.01, d=0.14	t=-2.28, df=61, p=0.02, d=0.39			
Pz					
Violent	t=-2.48, df=61, p=0.02, d=0.22	t=-4.74, df=61, p=0.01, d=0.28			
Erotic		t=-2.77, df=61, p=0.01, d=0.15			
Disgust					
Neutral		t=-2.56, df=61, p=0.01, d=0.43			

Table 72. Significant p-values from independent T-tests for the effect of preference towards watching violent or non-violent films, across site and epoch (adjusted alpha value =0.025).

	Epoch				
Region and Image Category	100	200	300	ELPP	LLPP
Fz					
Violent					

Erotic				t=-2.29, df=61, p=0.02, d=0.58	
Disgust					
Neutral					
Fcz					
Violent					
Erotic				t=-2.56, df=61, p=0.01, d=0.37	
Disgust					
Neutral					
Cz					
Violent					
Erotic					
Disgust					
Neutral					
Pz					
Violent					
Erotic					
Disgust					
Neutral					

Table 73. Significant P–values for pairwise comparisons across the effect of image across site and epoch.

Site	Epoch	Effect		
		Image	Difference Between Groups	P-value*
Fz	100ms	F(3, 59)= 3.18, p=0.03, ηp2=.05	Violent – Neutral	=0.02, d=0.37
	200ms	F(3, 59)= 24.38, p<0.001, ηp2=.29	Violent – Erotic	<0.01, d=0.60
			Erotic - Disgust	<0.01, d=0.65
			Erotic - Neutral	<0.01, d=0.84
	300ms	F(3, 59)= 18.38, p<0.001, ηp2=.20	Erotic - Disgust	<0.01, d=0.25
			Erotic - Neutral	<0.01, d=.56
			Violent - Neutral	=0.01, d=0.26
	ELPP	F(3, 59)= 11.01, p<0.001, ηp2=.16	Violent – Erotic	<0.01, d=0.46
			Violent – Disgust	<0.01, d=0.43
			Erotic - Neutral	<0.01, d=0.42
			Disgust - Neutral	<0.01, d=0.41
	LLPP	F(3, 59)= 12.05, p<0.001, ηp2=.17	Violent – Erotic	<0.01, d=0.57
			Violent – Disgust	<0.01, d=0.54

			Erotic - Neutral	<0.01, d=0.55
			Disgust - Neutral	<0.01, d=0.52
Fcz	200ms	F(3, 59)= 25.85, p<0.001, ηp2=.31	Violent – Erotic	<0.01, d=0.65
			Erotic - Disgust	<0.01, d=0.62
			Erotic - Neutral	<0.01, d=0.87
	300ms	F(3, 59)= 10.77, p<0.001, ηp2=.13	Erotic - Disgust	<0.01, d=0.55
			Erotic - Neutral	<0.01, d=0.61
	ELPP	F(3, 59)= 7.42, p<0.001, ηp2=.11	Violent – Erotic	=0.02, d=0.35
			Violent – Disgust	=0.02, d=0.33
			Erotic – Neutral	<0.01, d=0.37
			Disgust - Neutral	=0.02, d=0.31
	LLPP	F(3, 59)= 10.07, p<0.001, ηp2=.15	Violent – Erotic	<0.01, d=0.51
			Violent – Disgust	<0.01, d=0.49
			Erotic – Neutral	<0.01, d=0.48
			Disgust - Neutral	<0.01, d=0.47
Cz	200ms	F(3, 59)= 24.38, p<0.001, ηp2=.20	Violent – Erotic	<0.01, d=0.58
			Violent – Disgust	<0.01, d=0.28
			Erotic - Disgust	=0.01, d=0.33
			Erotic - Neutral	<0.01, d=0.42

	300ms	F(3, 59)= 5.52, p<0.001, ηp2=.07	Erotic - Neutral	<0.01, d=0.58
Pz	200ms	F(3, 59)= 3.58, p=0.02, ηp2=.06	Violent - Neutral	=0.03, d=0.32
			Erotic – Neutral	=0.03, d=0.33
	300ms	F(3, 59)= 2.70, p=0.05, ηp2=.04	Disgust - Neutral	=0.05, d=0.47
	LLPP	F(3, 59)= 5.69, p<0.001, ηp2=.09	Violent – Erotic	=0.03, d=0.37
			Erotic – Disgust	=0.03, d=0.20
			Erotic - Neutral	=0.02, d=0.51

*Values adjusted for multiple comparisons using Bonferroni correction

There were several main effects of sex, image and film preference. There were also several effects analysed showing interactions between sex x image and preference towards violent/non-violent films x image (see Table 70-073.). There were no constant patterns found across either variable but, it was shown that ERP amplitude was inconsistent across sex and the preferences to watching violent/ non-violent film variable.

4.7 Discussion

The main aim of this research was to conduct a large-scale study to test/validate the findings from the previous pilot study post minor modification and refinement of methodology (i.e. additional disgust stimuli category; more stringent participant inclusion criteria). One objective of this procedure was to investigate any potential differences in findings between the current results and published research that had previously had its methodology heavily criticised and to attempt to falsify and question theoretical stances (e.g. the GAM) on the effects of the media. In addition, this research included factors (i.e. sex, previous life experiences and lifestyle choices) that were considered alternative and potentially explanatory of within-group differences (e.g. Ferguson et al, 2008; Anderson & Bushman, 2001) that had been used to inculpate media content for neurological changes and subsequent aggressive behaviour.

Based on the former research (Ch.3.), three hypotheses were formulated. This research identified that there were sex differences in response to affective imagery; there were differences based on participant preference towards forms of VM and that there were differences in response that were moderated by personal experience of violent crimes. Thus, support for previous findings (i.e. Ch.3.) was provided. There were differences found in mean ERP amplitude towards all four stimuli categories (Neutral, Violent, Disgust & Erotic), across four measurement cluster sites (Fz, Fcz, Cz & Pz) within the defined epochs (100ms, 200ms, 300ms, ELPP & LLPP) However, closer within-sex investigation questioned the reliability of three of the independent variables. In addition, there was no evidence to conclusively support, or refute, the theoretical stances of the GAM, IEM, SLT or CMoA in the effect of the media. In comparison, there was evidence to suggest that biological sex moderated differences in response and processing of visual stimuli and that attention is motivated toward depictions of interest.

4.7.1 Overall Trends (Non-Category Specific)

In support of the previous research, the current study found that there were sex differences in response to affective imagery. However, in this research, females tended to respond with significantly increased mean ERP activation over the frontal site in early epochs and males were found to respond with increased activation over the central site and opposing polarity in the parietal measurement region in comparison to females. Interestingly this trend was in response to all image categories (except from in response to erotic images in the ELPP epoch) in comparison to just in response to affective imagery (e.g. Lithari et al., 2010). Therefore, this research added to the growing body of literature demonstrating sex differences in emotional processing and neurobiology (Glaser et al., 2012; Lusk et al., 2017; Lykins et al., 2008; Ruigrok et al., 2014; Rupp & Wallen, 2008; Victor et al., 2017). Furthermore, these findings supported research suggesting that females have an early negativity bias towards emotive stimuli (e.g. Gardener et al, 2013; Lithari et al, 2010) and are more responsive towards affective imagery in early epochs. However, previous research has found the most pronounced sex differences were evident in central and left frontal regions (e.g. Lithari et al,.2010). The current research found that there was a concentration of significant differences in the 100ms and 200ms epochs with the majority of differences found over central and parietal regions (see Ch4.6 Results).

In general, males tended to demonstrate an increased response over the later epochs (300ms, ELPP & LLPP) except from at the parietal measurement cluster where females tended to respond with increased positivity towards the differing image categories. Consistent with Hajcak et al. (2010) and Godleski et al. (2010) this could reflect an increased allocation of cognitive resources (i.e. attention) elicited in response to salient visual stimuli over the later epochs.

These basic observations mount further evidence to suggest that research using visual stimuli or research investigating early processing should ensure that sex has been accounted for within methodology. This is not restricted to EEG research rather should be acknowledged within a wider framework as the failure to do so may be introducing unnecessary confounds.

4.7.2 Violent Category Content

The majority of sex differences found were in response to the violent image category across the Cz and Pz sites. Females tended to respond with increased negativity over frontal regions in the early epochs and increased positivity in parietal region over all epochs towards violent images. In general, these findings supported the previous findings suggesting that females tend to be more responsive towards emotive content than males (e.g. Anokhin et al., 2006; Filkowski, Olsen, Duda, Wanger, & Sabatinelli, 2017; van Hooff, Crawford, & van Vugt, 2011) and that the amplitude of response was maximal in frontal regions over early epochs and over the Cz and Pz sites in later epochs (Lithari et al., 2010). However, no direct evidence was provided, in either direction, for theory and research suggesting that VM has a detrimental effect on neurological response.

Current results indicated that there were several significant differences in mean ERP amplitude based on preference towards violent or non-violent VVGs. Those in the NVVG group were found to show increased negative amplitude in frontal sites over the 100, 200 and 300ms epochs and a reduced positive amplitude in the LLPP epoch at the Cz site in comparison to those in the VVVG group. Thus, despite the fact that neural desensitisation has been identified as the biological cause of the regularly reported negative effects of long and short–term exposure to VM (e.g. Bartholow et al., 2006; Browne & Hamilton-Giachritsis, 2005; Engelhardt, Bartholow, Kerr, et al., 2011; Groves & Anderson, 2015; Groves et al., 2016), the current research found no evidence to support the theory of desensitisation. Current results showed that those who preferred to play violent videogames demonstrated an increased positive activation over the 300ms epoch and slightly reduced activation in the ELPP epoch in comparison to those who preferred to play non-violent VVGs however, there were no significant differences found between groups. Similarly, preference towards watching violent films (that had demonstrated significant differences in the previous research found in chapter 3.) showed no significant differences over the 300ms or ELPP epochs or in the parietal region. In addition, those in the violent film preference group responded with a marginally increased mean ERP amplitude in comparison to those in the non-violent preference group. However, there was a slight, non-significant reduction in ERP amplitude demonstrated for the within male violent preference group in comparison to the nonviolent preference group. Thus, no evidence was found to support the desensitisation effect for violent film or VVG preference. This suggested that preference towards media violence did not mediate significant differences in response towards violent imagery in the parietal region over any epoch.

However, there was a lack of consistency found during analysis that required further investigation. This was highlighted for the results of between groups factors (i.e. 2 levels of an IV) and within group factors (i.e. males x 2 levels and females x 2 levels) across the epochs. The lack of consistency among the between-group and within-group (i.e. sex) findings suggested that the use of the IV's that measured preference towards violent media or personal experience of violent crimes were potentially unreliable for the purpose of group differentiation. Thus, on a biological level, current results demonstrated that there was no evidence to support the SLT, GAM, IEM, CmoA or desensitisation effect. However, again there was support for research and theory suggesting that sex is an important modifying factor in neurological processing of visual stimuli that should be adopted throughout neurological and media research when the processing of visual stimuli is a requirement of experimentation. This finding supported contemporary neuroimaging research (Szycik et al., 2017).

4.7.3 Erotic Category Content

Typically, images of a sexual nature have produced an increased ERP amplitude in central and parietal regions over later epochs (e.g. Van Lankveld & Smulders, 2008) in comparison to alternative content (e.g. highly arousing sports or neutral stimuli). The current research supported this trend (see Tables 26 -69).

Recent interest has focused on the effects of pornography addiction (Kuhn & Gallinat, 2014; Love et al., 2015), consumption (Kunaharan et al., 2017) and differences in response between controls and paraphilics (Habermeyer et al., 2013; Waismann et al., 2003). Despite the provision that there are sex differences in sexual arousal and associated behaviours (Stoleru, Fonteille, Cornelis, Joyal, & Moulier, 2012), investigations and reviews have tended to focus efforts on understanding male samples. The current research found fundamental visual processing differences of erotic imagery between the sexes. These differences may help identify and explain the mismatch between sexual behaviours such as sexual aggression if future research took advantage of understanding the response for both sexes.

Within this research it was shown that in general, males tended to respond with an increased negativity in the 100ms epoch across measurment sites, increased negativity in frontal regions (Fz and Fcz) for the 200ms epoch and an increased positivity in the parietal region over the ELPP and LLPP epochs towards erotic images in comparison to females. In general, studies focusing on response towards visual sexual stimuli has demonstrated that interest (self rated) and neurological response has been dominated by males in comparison to females. Waismann et al. (2003) suggested that the P600 over the pareital region was the best predictor for sexual interest in visual stimuli. Thus, the ELPP epoch would encapusulate this timing and there were visual differences between the sexes over this epoch; males tended to respond with more positivite amplitude. However, differences were non significant. As previously highlighted (Ch 3.), this could be related to stimuli content (i.e. intensity; erotic verses pornographic). These content issues may not have evoked a response typically expected in the population. This would require further investigation.

Alho, Salminen, Sams, Hietanen, and Nummenmaa (2015) found peaks in response to figures that were either clothed or nude approximately 145ms post stimuli presentation. However, an additional peak in amplitude was found at 205ms post stimuli presentation only in response to nude figures. Thus, it was concluded that body senstitive responses were focused around the extrastriate and fusiform regions in early (100ms and 200ms) processing and around areas most associated with motivation (e.g. insula and anterior cingulate cortex) for 200ms -300ms (Alho et al., 2015). In comparison to previous findings (ch. 3), the current results showed that there were significant sex differences in response to erotic imagery in early epochs (100ms and 200ms) over central and parietal measurment sites. The current research supported the suggestion that erotic stimuli was processed at a very early stage (Alho et al., 2015; Feng, Wang, Wang, Gu, & Luo, 2012) and furthermore, that there were sex differences in grand mean ERP amplitude across the early epochs. Thus, results were two fold, it has been identified that erotic stimuli is processed very rapidly and that there were sex differences in the early processing towards erotic stimuli.

There were no significant differences (either between groups or within sex) found in response to erotic stimuli based on whether the participant prefered violent or non violent videgogames. This suggested that preference towards VVG did not modulate resposne towards erotic content. However, significant differences were found dependant on whether the participant prefered watching violent or non violent films in frontal sites (Fz and Fcz) across the ELPP epoch. Those in the nonviolent preference group responded with an increased negativity over frontal sites in comparison to those in the violent film preference group. However, only the male groups were found to show a similar pattern of response based on this IV. Therefore, this sugested that the IV produced inconsistant results (i.e. both within sex groups did not show similar between group differences based on the IV). This could have suggested several things. Firstly, that sex differences in processing of affective imagery have been evident across all IVs and thus findings could be explained by sex. Secondly, potentially this IV moderated response for male participant groups only. Lastly, and most likely, that the dichotmous IV is an unreliable measure for group secregation. This would require further investigation that lies outside the aims of the thesis.

4.7.4 Disgust Category Content

The current research found early (100ms and 200ms) sex differences over frontal (Fz and Fcz) and parietal (Pz) sites and slightly later (ELPP) difference at the central (Cz) site. Females responded with an increased response (positive or negative) in each case listed above in comparison to males. Thus, this suggested that sex moderated response towards disgust content. This supported research and theory suggesting that there were sex differences in processing of disgust and unpleasant stimuli (e.g. Kemp, Silberstein, Armstrong, & Nathan, 2004; Lithari et al.2010) and that the sex advantage in emotion recognition may result from the attenuated sensitivity in early processing especially for females (Li et al., 2008; Lithari et al., 2010; Lusk et al., 2017).

There were several significant differences based on whether participants had been a victim or witness to a violent crime. Those who had been a victim or witness in the past responded with significantly reduced activation in the parietal (100ms, ELPP and LLPP epochs) and central regions (LLPP epoch) in comparison to those who had not been a witness or victim. Within sex group differences showed similar patterns of response between the female groups however, there were no significant differences between the male groups. Thus, this suggested that differences in response to disgust content were moderated by the IV however, the reliability of the IV was questioned due to the within sex differences. Further investigation is required to establish whether this IV is sex specific.

There were no significant differences in response to disgust images across any epoch or measurement region based on preference towards violent or non-violent videogames or preference towards violent or non violent films. The analysis of within sex effects found significant differences between groups in the male sample at both frontal clusters (Fz and Fcz) over the later epochs (ELPP and LLPP). Males who preferred watching violent films responded with a significantly reduced negative response in comparison to those in the non-violence preference group. This pattern was not replicated for females. There were no significant differences between the female groups in relation to disgust content. Thus, this demonstrated that for male groups only, preference towards violent films moderated response in frontal regions towards disgust content. These results should be accepted with caution due to the inconsistency between groups, across and within sex.

To date, the desensitisation effect has not been replicated within this research i.e. there were no significant differences found between neurological activation in the parietal region over either the 300ms or ELPP epochs, for those who had a preference toward VM or for those with personal experience of violent crime in response to violent stimuli; these participants tended to show slightly increased mean ERP activation in comparison to those in the nonviolent / no experience groups. However, it was suggested that the addition of disgust images unevenly dispersed among the violent stimuli may have impacted the results and led to potentially spurious findings regarding VM (e.g. ch.3). To clarify, perhaps it was the disgust element of VM and/or the use of confounded violent stimuli in previous research that produced the desensitisation effect. If this was the case, it may further impede on understanding the true effects of digital media on the brain and the disgust content may impact the ability to make sound moral judgements on future behaviour (i.e. to act in an aggressive or sexually aggressive manor). The latter would require extensive continued investigation beyond this thesis. However, the aim of adding this stimuli category was to illuminate any previously missed reasoning for desensitisation effect and in order to attempt to falsify theoretical (i.e. the GAM; CMoA; IEM) positions and in order to maximise thorough investigation into the effects of the media, the addition of this category was considered viable and just.

The current results demonstrated that disgust content moderated response based on several alternative factors (preference towards violent media and previous personal experience of violent crime) and potentially provided a basic explanation towards why some media research have found reduced activation for participants placed in ‘violent’ groupings and exposed to violent stimuli that has been sporadically interspersed with disgust content (e.g. Bartholow et al, 2006). Across the significant differences found, there was support for research showing that females respond with increased activation over early epochs in frontal sites towards affective imagery (Lithari et al., 2010).

Therefore, overall, there was some support for the suggestion that disgust stimuli had a desensitisation effect on response towards content. For example, this research has shown that response for those in violent preference groups and those who had personal experience of violent crime demonstrated significantly reduced neurological activation in comparison to those who prefer non-violent media and have no personal experience of violent crime. However, findings were not consistent across region (i.e. significant differences found at the Pz cluster across IV's) or epoch (for example the 300ms epoch). In fact, as surmised in ch.3, the later ELPP epoch appeared to encapsulate the effect. However, it is important to note that these findings were identified in relation to disgust content, not violent as the GAM and desensitisation effect predicted. Thus, this research cannot offer any direct support for either. Still, this investigation has demonstrated that single content categories are imperative within neurological research. Furthermore, this research has highlighted, and questioned, the reliability of the IV's for dichotomous categorisation due to the inconsistency across within-sex groups. Lastly, this study has identified a possible explanation for the proposed desensitation effect that may have been previously overlooked due to the erroneous categorisation of stimuli resulting in findings being misinterpreted.

4.7.5 Neutral Category Content

Typically, neutral images have been used as a baseline for reference to measures for alternative categories (i.e. difference measures for neutral verses violent content) (e.g. Codispoti et al., 2007; Coyne et al., 2008; Cuthbert et al., 2000; Keil et al., 2002; Kemp et al., 2004) or have been used to reduce habituation effects in for example, the oddball task where one target image is placed among a group of neutral to evoke a response to the target (e.g. Engelhardt, et al,.2011). For the purpose of this EEG experimentation and in order to be used as a viable neutral category, neutral content should evoke minimal (deviation from zero) EEG activation (amplitude and frequency) and by definition, should produce no differences between groups, across the sample population.

However, in support of the previous research (Ch.3.), several differences were found in response to the neutral image content (i.e. differences moderated by sex, preference towards playing VVG's and preferences towards watching violent films). Females responded with a significantly increased negativity in the Fz region and an increased positivity in the Pz region for early epochs (100ms and 200ms) in comparison to males. Males responded with an increased negativity in early epochs at the Cz cluster. This was demonstrative of sex differences in early processing and the early female negativity bias in frontal sites (e.g. Lithari et al, 2010). Significant differences were also found between those who preferred to play VVG in comparison to those in the non-violent preference group. Those in the non-violent group demonstrated significantly increased negative (occasionally opposite polarity) activation in the frontal regions across epochs (200ms, 300ms, ELPP and LLPP) in comparison to those in the violent preference group. Within sex analysis showed a similar pattern between the male groups but there were no significant differences between the female groups. Thus, potentially demonstrating that the IV was unreliable across sex or that differences were sex specific. This issue was also highlighted for the analysis of between groups of violent or non-violent film preference. There were no differences found between groups but, for within-sex analysis there were differences between the male groups over the 100ms epoch in both frontal measurement clusters. Thus, this potentially highlighted an issue with the IAPS image content as findings showing significant differences in response between samples as has clearly been shown, demonstrated a variance in the general public that exceeds the expected (e.g. Field, 2014) and suggested that there is a need for closer scrutiny over the reliability of factors such as preference towards VM being used as an IV.

The differences found in response to neutral images have again questioned the neutrality of the images provided by the IAPS especially where the images have been used as a reference or baseline in comparison to affective content as results may have been impeded. The differences noted could be a response to the confounded content (i.e. the presence of faces and figures). In addition, there was no consistency to the quality of the images provided thus, the image resolution of certain stimuli may have impacted on processing (although it is acknowledged that it could be argued that the effects of this should have been consistent across IV). Similarly, basic photography rules have not been followed in many of the images (e.g. the rule of thirds) which could have led to changes in perception and consequently processing of content (Davis, 2011; Sahlin, 2011). Although these points were not category specific it has highlighted the fact that a closer examination of stimuli category content is required in order to further understand the relevance of the differences found.

4.7.6 Summary

This research has established, by no means exhaustively, that many factors alternative to aggression, such as sex, personal experience of violent crime and individual preference towards certain types of VM had an impact on neurological activation in response to affective images.

However, questions have been raised regarding the reliability of some of these IV's due to inconsistencies between and within groups (i.e. sex). Additionally, there was support for many findings from the pilot scale study (ch.3.) and clearly supported the need to include sex as an independent variable in research investigating processing of visual stimuli.

Although, there was no current evidence to support or directly refute the GAM (Anderson and Bushman, 2002) or the IEM (Malamuth and Briere, 1986), some support was found for the CMoA as this model suggested that there were many more potential factors instead of just violent media, that had not been considered (Ferguson, Rueda, et al, 2007). In addition, there was no support for the desensitisation effect in relation to VM (e.g. Engelhardt et al., 2011).

This research has identified several issues with content and context of presented stimuli that could be viewed as contributing factors to the inconsistency of results across and within sex. These factors require additional investigation in order to identify their relevance and potential impact. Despite this research raising further questions, what appears indisputably clear is that media research still requires continued, extensive investigation prior to any further theorised, or research-based claims of irrefutable links between the media exposure and subsequent behaviour.

4.8 Overarching Findings

There was insufficient evidence to support or refute the predictions of The General Aggression Model (Anderson & Bushman, 2002) and the Indirect Effects Model (Malamuth, 1986).

This research supported the previous small-scale investigation (Ch.3.).

The results supported several key findings from previous literature for example; the early female negativity bias (Lithari et al., 2009); sex differences in visual stimuli processing (e.g. Lusk, Carr, Ranson, & Felmingham, 2017; Lykins, Meana, & Strauss, 2008; Ruigrok et al., 2014; Rupp & Wallen, 2008; Victor, Drevets, Misaki, Bodurka, & Savitz, 2017) and highlighted important avenues for further research such as stimuli content and context.

4.9 Key Findings

There were significant sex differences found in all epochs and sites in response to the image categories. This suggested that biological sex moderated ERP response towards affective visual stimuli.

Sex should be treated as an IV in EEG research.

There was no evidence to support the desensitisation effect in response to violent visual stimuli.

Although there were significant differences found between groups that were moderated by previous life experiences and lifestyle choices as specified in the literature, there was no consistency to the findings for within-sex analysis therefore, this identified a potential reliability issue with these IV's.

Chapter 5 **What Are You Looking At? The Highs and Lows of Aggression. Why Standardisation Would Help.**

5.1 Abstract

Aggression research has employed a diverse selection of measures. However, taking a methodological perspective, there has been inconsistency across procedure, analysis and reporting that has impacted objectivity and validity of findings. The BPAQ (Buss & Perry, 1992) has been viewed as the gold standard psychometric measure of trait aggression (Gerevich, Bacskai, & Czobor, 2007). Total scores range from 29 – 144. However, there has been minimal literature defining high/low scores or where the limit (cut-off) should be in order achieve dichotomous categorisation. Four data categorisation techniques were employed with weighted by sex analysis included; using the data median, arbitrary value defined by known violent offender scores; 25th and 75th percentile scores and K-clustering method. Participants (n = 78) completed questionnaires (the Buss and Perry Aggression Questionnaire and a demographic questionnaire) prior to passively viewing images from four categories (Violent; Erotic; Disgust and Neutral) over 1000ms. The images were provided by the International Affective Picturing System (Lang et al., 1997, 2008). In line with previous research, these results showed that trait aggression appeared to modulate response toward affective imagery, but this was found to be dependent on method and was sex specific (only evident for male groups). Those high in trait aggression tended to respond with increased ERP activation towards stimuli categories. In addition, results demonstrated that there was inconsistency between data processing methods that suggested there is a need for standardisation across the field. Further implications and future directions have been discussed.

5.2 Introduction

Despite the link between media exposure and aggression being referred to as clear and causal (Allen et al., 2018; Anderson & Carnagey, 2004, 2009; Bartholow et al., 2006; Bartholow et al., 2005; Carnagey, Anderson, & Bartholow, 2007; Engelhardt, Bartholow, Kerr, et al., 2011; Engelhardt, Bartholow, & Saults, 2011; Groves & Anderson, 2015a, 2015b; Groves et al., 2016), many researchers have failed to replicate or find evidence to support these claims (e.g. Barnett & Coulson, 2010; Ferguson, 2007a, 2010; Ferguson & Cricket Meehan, 2010; Ferguson & Dyck, 2012; Ferguson, Olson, Kutner, & Warner, 2014; Ramos, Ferguson, Frailing & Romer-Ramirez, 2013; Savage & Yancey, 2008; Sherry, 2001; Szycik et al., 2017). In contrast, there has been a formation of critiquing arguments regarding methodological choices and unjustified assumptions that has produced sensible questions yet to be answered or explained (see Ch. 1 for more detailed review).

The GAM's (Anderson and Bushman, 2002) long-term processes (see Figure 2.) have explained how media exposure (e.g. VM and EM) whether real-life or fiction, can provide the rehearsal and reinforcement of relational cognitive scripts that over time, transform and mutate beliefs, attitudes, perception, behavioural norms and desensitise the individual towards the content (Allen et al., 2018; DeWall, Anderson, & Bushman, 2011; Engelhardt, Bartholow, Kerr, et al., 2011; Funk et al., 2004; Groves et al., 2016). Therefore, the repetitive aggressive script formation and frequent retrieval via exposure to media content has permanent modifying effects on the brain and personality (e.g. trait aggression) (Anderson et al., 2010). In accordance with these explanations, both the GAM and IEM imply that aggression would impact neurological response towards violent and erotic imagery (Anderson and Bushman, 2002; Malamuth and Hald, 1986), especially where preference or previous exposure was high. It would be practically impossible under the constraints of this thesis to find a representative sample of participants that could act as a neutral or 'non-exposure' group. This is due to the way that the media has become an entangled and integral part of society within western society (see Ch 1. for overview of statistics). However, the VM preference and exposure level would require additional future investigation as previous research has questioned the reliability of the IV's (e.g. preference towards VM; personal experience of violent crime) formerly used as measures (see Ch 4.7).

Researchers have employed a wide range of methods in order to measure aggression (Elson, Mohseni, Breuer, Scharkow, & Quandt, 2014; Walters & Zaks, 1959). Notable measures have been for example; the number of needles used to puncture a voodoo doll (Dewall et al., 2013) and dart throwing accuracy towards images of human faces (Mussweiler & Förster, 2000). However, probably the most widely adopted approach has been to permit participants to administer a form of 'punishment' to an opponent (Anderson and Carnegey, 2004) using a variety of methods and techniques. Many of these methods have just slightly adjusted and manipulated its predecessor in order to obtain data within the constraints of ethical correctness. For example, the use of electrical shocks as an aversive stimuli in the original Taylor Reaction Competitive Time Test (TRCTT) (Taylor, 1967; Phillips & Giancola, 2008) have been modified to use compressed air on the fingers (Lotze, Veit, Anders, & Birbaumer,

2007) or deliver a noise blast to the ears (Anderson & Dill, 2000; Denson, Capper, Oaten, Friese, & Schofield, 2011; Denson, Pedersen, et al., 2011; Engelhardt, Bartholow, Kerr, et al., 2011; Wiswede et al., 2011). In the TRCTT original method, participants were led to believe that they would be taking part in 25 trials of a reaction testing game against an opposition where the winner of each round could deliver an electric shock as punishment to the opponent. If participants lost, they would receive a shock with an intensity that was randomly selected. If the participant won, they adjusted the shock levels for their 'opponent' and these levels were recorded and viewed as a measure of aggression.

However, there have been several researchers that have questioned the validity and reliability of both the original and updated variations of the measure (Adachi & Willoughby, 2011, 2013; Ferguson & Rueda, 2009; Ferguson, Smith, et al., 2008; Tedeschi & Quigley, 1996, 2000). For example, there has not been an option to 'deliver no shock/blast' therefore, it was suggested that the method encouraged participation in modifying the duration and intensity of the punishment via prior 'learning' and failed to provide a non-aggressive alternative behaviour that would invite free thinking and representation of intention (Tedeschi & Quigley, 1996, 2000). Via the use of this method, it is impossible to measure intention or cognition, which is, by definition required to characterize aggression (Baron & Richardson, 1994). Adachi and Willoughby (2011) argued that the TRCTT effectively measured competitiveness rather than aggression. However, it could be suggested that to a certain degree, it has been a measure of human obedience (Tedeschi & Quigley, 1996, 2000) and demand compliance where participant behaviour replicated what they thought was expected of them. In either sense, the TCRTT could be regarded as lacking in both face and ecological validity in this context.

Alongside the apparent validity concerns, the research field has employed a variety of procedural and data processing/ analysis methods and modifications of the measure and the subsequent statistics (e.g. Anderson & Dill, 2000; Anderson & Murphy, 2003; Bartholow et al., 2005; 2006; Carnagey & Anderson, 2005; Engelhardt, Bartholow, Kerr, et al., 2011; Engelhardt, Bartholow, & Saults, 2011; Hasan, Begue, & Bushman, 2013; Hasan, Bègue, Scharkow, & Bushman, 2013) without ostensible justification or adequate detail. Elson (2016) stated that variants across data processing and analysis (by the same author on many occasion) had appeared to provide results that sought to support their hypothesis. Elson (2016) demonstrated that there had been over ten different data procedures used within recent literature on how to calculate the aggressive behaviour score using the TRCTT. For example, the multiplication of every trial's volume and duration (Bartholow et al., 2005), using the volume and square root of duration (Carnagey & Anderson, 2005); via the standardized and summed volume and duration (Bartholow, Bushman, & Sestir, 2006); separately complied average volume and log-transformed duration settings across each outcome (wins and losses) (Anderson & Dill, 2000); average volume without accommodation for duration settings (Sestir & Bartholow, 2010); summed high volume settings only, i.e. 8 to 10 (Anderson & Carnagey, 2009). This flexibility and inconsistency across data collection, analysis and reporting was shown to be a major factor in dramatically increased false-positive results (Simmons, Nelson, & Simonsohn, 2011) that ultimately leads to spurious interpretations of results (Elson, 2016; Elson et al., 2014).

Without standardised procedure, processing and analysis, it invites questions whether the raw or processed score can truly represent the construct being measured (Field, 2013; Luck, 2014b). Moreover, the unstandardized methods, procedure, processing and analysis makes comparisons between research findings troublesome. Based on the assumption that all methods of measurement have been equally reliable and able to quantify aggression, it begs the question why modify an acceptable one? Where sound hypothesis driven changes are adopted and applied with the aim to answer specific questions or meet new ethical requirements, Elson (2016) stated that there can often be valuable contribution and scientific extensions made to knowledge. However, there has been a lack of explanation and detail which has fed critique regarding post hoc choice of processing and analysis (Elson, 2016; Elson et al., 2014; Ferguson, 2007a; Ferguson & Dyck, 2012; Ferguson et al., 2013; Ferguson, Smith, et al., 2008; Ramos et al., 2013; Simmons et al., 2011) that has fueled discussion regarding alternative agendas of research (Wagenmakers, 2007; Wagenmakers, Wetzels, Borsboom, van der Maas, & Kievit, 2012). This does not support the field or the aim of identifying the true effects of media exposure.

One standardised measure of aggression that has been considered the gold-standard is the Buss and Perry (1992) Aggression Questionnaire. This self-report quantitative measure has been viewed as an ethical tool to gauge aggressive behaviours and cognitions. The BPAQ (1992) was the product of multiple factor analyses that modernised the Buss-Durkee Hostility Inventory (Buss & Durkee, 1957). The BPAQ has been widely adopted and continues to be a highly regarded psychometric measure (Gerevich, Bacskai, & Czobor, 2007). The 29-item questionnaire records self-reported aggressive traits with summed scores across the four subcategories (Physical Aggression (PA), Verbal Aggression (VA), Anger (A) and Hostility (H)) producing a total aggression score. High test/retest reliability, construct and internal validity for the subcategory scales have been found alongside cross-cultural validation (Felsten & Hill, 1998; Gerevich et al., 2007; Pechorro, Barroso, Poiares, Oliveira, & Torrealday, 2016). According to Buss and Perry (1992), trait aggression identifies a personality with a tendency towards hostile cognition and a wiliness to participate in forms of physical and verbal aggression (Buss and Perry, 1992). Thus, suggesting that high total scores would be produced from those who were behaviourally, and cognitively, different from those in a low scoring group (Archer, 2004; Archer & Webb, 2006; Stanford, Houston, Villemarette-Pittman, & Greve, 2003; Zillmann & Weaver, 2007).

Although the use of the tool and the calculation of subcategory traits and total score has been standardised, there has been no validated or confirmed value where high and low scores could be adequately differentiated. Alike the inconsistency described above for the use of the TRCTT, there have been a variety of data analysis and processing methods employed when using the BPAQ (e.g. only using one sub-category; using the all subcategories separately or total scores). For example, Engelhardt, Bartholow, Kerr, et al. (2011) used a 25^{th} /75^{th} percentile split for violent exposure with the top 25% and bottom 25% of scores being plotted against each other. Whereas, a median method was employed by Engelhardt, Bartholow, and Saults (2011) where data was grouped either side of the median value. Alia-Klein et al. (2014) chose to only use data from participants who scored higher than the 75^{th} percentile on the PA subcategory and reported physical fights during the previous year in comparison to those who did not report physical fights in the previous year and scored below the 50^{th} percentile on the data from the PA subcategory. In chapter 3 of this thesis, it was considered that those who were known offender bullies (Palmer & Thakordas, 2005) or violent offenders (Smith & Waterman, 2004) would differentiate cognitively and/ or behavioural between controls therefore the potentially arbitrary value of 81 (known aggressive mean value) was used to define a cut-off value.

These methods, although justified, could potentially be reasoning for differences in findings across research (Ferguson, Rueda, et al., 2008; Simmons, Nelson & Simonsohn, 2011). Thus, the median cut-off; the data 25^{th}/75^{th} percentile cut off and the offender directed cut off of 81 were three methods that were employed within this research to provide dichotomous variables (High and Low trait aggression groups) and to investigate the effects of the relatively minor changes in data analysis and grouping techniques that have been previous employed has on overall ERP results & subsequent meaning of the findings.

In order to avoid criticism of being arbitrary and without principle, the use of an automatic method, for example, a clustering algorithm (e.g. k-means clustering) was used as a fourth technique to produce two statistically distinct groups (k=2). This method is simplistic and has usually been adopted as an initial step in large cluster analysis procedures (Zakharov, 2016). The main objective of the K-Clustering algorithm is to minimise the data variance across each cluster and maximise the Euclidean (geometric) distance between the cluster groups. This is achieved by diminishing the amount of squared distance between cluster centroids using an iteration method (Xu & Wunch, 2008; Zakharov, 2016).

Sex differences in trait aggression scores have been reported (e.g. Buss & Perry, 1992). Traditionally, females have tended to score higher on VA and males on PA and A. However, there has been inconsistency to these findings (Keller et al., 2008; Ramirez et al., 2001). In conjunction with the evident sex differences in ERP amplitude towards visual stimuli (e.g. Lithari et al, 2010), it was considered appropriate to use the following data methods across and within sex (where appropriate). Thus, it was expected that there would be significant differences in neurological response between high (High Aggression Females (HAF); High Aggression Males (HAM)) and low (Low Aggression Females (LAF) and Low Aggression Males (LAM)) scoring groups towards visual stimuli. Gagnon et al. (2017) found a significantly increased N400 for aggressive rather that nonaggressive individuals in response to words with hostile intent. Whereas, Bartholow (2006) conducted several different regression analyses, some of which were to investigate whether recorded ERP amplitude in response to VM could predict response in the TRCTT. An inverse relationship was found, small P300 amplitudes were associated with highly aggressive behaviours as measured via scores on a version of the modified TRCTT. It was shown that NVVG players responded with an increased ERP amplitude towards VM in comparison to VVG players, using a median data split (see Bartholow, Bushman & Sestir, 2006; Figure 2. for visual representation) and it was concluded that this demonstrated the desensitisation effect for VM.

The desensitisation effect was supported by Engelhardt, Bartholow, Kerr, et al. (2011) whom also used a version of the modified TRCTT to measure aggression and found that those low in previous exposure to VVG who then played a VVG, demonstrated a reduced P300 amplitude in comparison to those who played a NVVG. Although, using a median split in trait anger scores, Engelhardt, Bartholow, and Saults (2011) found no significant differences based on the A subcategory of the BPAQ between high and low scorers with alpha set at 0.05. Yet, the authors did report minor differences with alpha set at 0.09. However, there has been no consistency to these findings except from the concluding commentary from a relatively close circle of researchers. Even when standard statistical thresholds have been relaxed, there has been no support for the desensitisation effect found and moreover, no significant differences noted between VVG groups using emotive imagery (Szycik et al., 2017). Szycik et al (2017) suggested that this may be due to the variety of methodologies and processing techniques adopted across the field. Yet, there has been no research that has aimed to use a variety of data processing methods to investigate this point in relation to the media effect and aggression.

Conventionally, there has been an increased ERP response towards affective stimuli in comparison to neutral and especially toward erotic or threatening content (Cuthbert, Schupp, Bradley, Birbaumer, & Lang, 2000; Schienle, Schafer, Stark, Walter, & Vaitl, 2005; Schupp et al., 2000; Schupp, Cuthbert, et al., 2004; Schupp, Junghofer, et al., 2004). However, based on the GAM (Anderson & Bushman, 2002) and the desensitisation effect (Bartholow et al., 2006), it was expected that response between high and low scoring trait aggression groups would be significantly different for violent content irrespective of data processing method undertaken. To be effective, this would be evident across group and within sex. Furthermore, it was hypothesised that there would be differences in results between data methods (i.e. Cut off point at 81; Data Median; 25th and 7th Percentile and K-Clustering).

Therefore, this research intended to investigate the differences in ERP activation towards affective media based on total trait aggression scores. In addition, it aimed to access and address concerns over basic manipulations in data analysis that may influence the results and potentially give solid evidence for standardisation with clear, justified reasoning for decisions made regarding the methodology employed (i.e. standardised methods of measurement) and statistical data analysis (i.e. minor variations in processing techniques) that could be seen as methods to manipulate or select results that produce support for hypotheses (Fanelli, 2011, 2013; Ferguson, Rueda, et al., 2008; Ferguson, Smith, et al., 2008; Heene & Ferguson, 2017; Schonemann & Scargle, 2008; Witte & Zenker, 2017)).

5.3 Key Aims & Hypothesis

Investigate differences between published research data that has had the methodology negatively critiqued and the results from the current study, to provide a baseline for further studies.

Investigate the differences in ERP activation towards affective media based on total trait aggression scores (both between groups and within sex) using a standardised psychometric measure of aggression.

Understand the effect of minor changes in data processing (Cut off of 81; Media method; 25th and 75th Percentile or K-Clustering) and data grouping of dichotomous variables (High and Low aggression) has on overall ERP results & subsequent meaning of the findings.

Hypothesis 1. There will be significant differences between those in high aggression groups in comparison to those in low aggression groups in response to affective imagery. These should be found between within-sex groups (i.e. differences between high and low females and high and low males) to demonstrate validity and reliability of the IV aggression as measured by the BPAQ.

Hypothesis 2. There will be differences in results based on data processing method (Cut off of 81; Media method; 25th and 75th Percentile or K-Clustering).

5.4 Methodology

The methodology undertaken was that provided in the previous chapter. All raw data used within this chapter were extracted from Chapter 4.

5.4.1 Participants

An opportunity-based sample of 78 healthy right-handed volunteers (Male N= 35; female N= 43) were recruited to take part in this research. There was a broad age range (females mean= 22.53, SD= 5.82, range 18-38; males mean= 21.57, SD= 4.94, range 18-39). The sample were not paid for their participation, however, first and second year psychology students were awarded research credits for participating. All of the participants had normal or corrected to normal vision, 20/20 (UK). Participants with a history of mental health illness and those currently taking un/prescribed medication were excluded from the study.

5.4.2 Procedure

The experimental procedure was as outlined in the methodology chapter (see Ch 2.2).

5.4.3 Data Analysis

The data was processed and analysed as outlined in the methodology chapter (Ch. 2). The data used in this chapter was collected during the experiment for Chapter 4 however, the aggression element was allocated an additional chapter to enable thorough analysis of results. There were 4 different statistical techniques employed to extract distinct dichotomous groups of high and low trait aggression scores. Each method provided four IV's: High Aggression Females (HAF); High Aggression Males (HAM); Low Aggression Females (LAF); Low Aggression Males (LAM).

The statistical techniques were used to allocate participants to groups. The first technique was to use a cut off value that was previously implicated as scores from a known offender sample (Palmer & Thakordas, 2005). If a total trait aggression score was equal or greater than 81, the participant was assigned to the high trait aggression group. Those scoring 80 or below were assigned to the low aggression score group. This provided Method 1.

The second data analysis technique was to use the data median as this value is current data specific and relevant to access a group divide. Thus, scores above the median were assigned to the high aggression groups and scores that fell below the median were assigned to the low aggression groups. The data median was 73. In addition, total aggression scores significantly differed between the sexes ($t=2.00$, $df=76$, $p=0.05$) with differences in median values reported (males=75 and females=69). Thus, an additional analysis was conducted. The within sex values (weighted by sex) were calculated for both males (25th percentile=66 and 75th percentile= 82) and females and formed the groupings for the 'weighted' sub-section (see Ch 5.5.2). These provided Methods 2 and 3.

The third technique reduced the sample size by half as it used the 25th and 75th percentile as cut off values for the low and high aggression scores. In addition, there was different values across sex (overall) and within sex. Therefore, the 25th and 75th percentile values were calculated for an overall analysis and then a within-sex analysis. Overall group values were calculated, and groups were allocated based on their overall value (25th percentile= 57.25 and 75th percentile= 81.25). The within sex values were calculated for both males (25th percentile=66 and 75th percentile= 82) and females (25th percentile=53 and 75th percentile= 75), this data formed the groupings for within-sex (weighted by sex value) sub-section (see Ch 5.5.3). These provided Methods 4 and 5

The final data technique was to use an automatic clustering algorithm (K-Clustering) to specify which participant scores clustered around two groups. This was conducted using SPSS v 22. This technique allocated participants into high and low trait aggression groups by maximizing the differences between clusters based on the total aggression score and within 10 iterations. All inferential analyses were conducted as provided in the methodology chapter (see Ch 2.). This provided Method 6.

5.5 Results

EEG amplitudes were recorded and standard descriptive statistics have been summarised in the below sequence of tables (see Tables 74 – 103). As predicted, there were significant differences in response to affective imagery between high and low trait aggression scoring groups (see Appendix V to AG for full inferential result tables). Results have been subdivided into the following subsections for clarity; Trait aggression- Cut off point at '81' (Ch 5.5.1); Trait aggression- Data Median (overall and within-sex) (Ch 5.5.2); Trait aggression- 25th and 75th percentile (overall and within-sex) (Ch 5.5.3) and Trait aggression – K-Clustering (Ch 5.5.4).

The data was segmented into epochs (100, 200, 300 and ELPP and LLPP) as outlined in Chapter 2.2.7 Epochs. Four cortical measurement sites were selected; the frontal region (Fz), frontal central (Fcz), central (Cz) and parietal (Pz) that formed the cluster sites. The mean trait aggression score across all participants was 69.53 (SD=16.69) with a relatively large range in scores of 73 (33-106).

5.5.1 Method 1: Trait Aggression (Cut Off point at '81')

This is the analysis of trait aggression using a cut off value of 81 by location and epoch to affective images. Data was separated by sex and subdivided by total aggression score. Descriptive statistics have been provided in the below succession of tables for mean ERP amplitude in response to image (see Tables 74-79). Total aggression score means were similar across high (HAF mean=88.67, SD=7.62; HAM mean=88.08, SD=7.35) and low groups (LAF mean= 60.24, SD=13.47; LAM mean=64.76, SD=12.91). As predicted, there were significant differences in response towards affective imagery between high and low trait aggression scoring groups (see Appendix V and W for full tabulated inferential statistics).

5.5.1.1 50 – 150ms Post Stimuli (100ms)

Table 74. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 100ms timeframe.

100ms	High Aggression Females (n=9)		High Aggression Males (n=12)		Low Aggression Females (n=21)		Low Aggression Males (n=34)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.26	1.68	0.31	2.55	-1.30	2.06	-0.52	1.82
Violent	-2.02	1.62	-1.26	0.79	-1.42	1.79	-1.22	1.81
Erotic	-0.48	1.48	-1.42	1.87	-1.05	2.72	-1.40	2.54
Disgust	-1.02	1.25	-0.03	0.75	-1.53	1.95	-0.66	1.63
Fcz								
Neutral	-1.67	1.46	-0.41	1.61	-1.49	1.80	-0.98	1.54
Violent	-2.41	1.63	-1.32	0.99	-1.49	1.48	-1.46	1.60
Erotic	-1.18	1.00	-1.24	1.58	-1.17	2.12	-1.69	2.25
Disgust	-1.69	0.94	-0.44	0.80	-1.65	1.77	-1.18	1.51
Cz								

Neutral	-0.64	0.92	-1.65	1.78	-0.79	1.31	-1.90	1.14
Violent	-0.83	1.91	-1.17	1.69	-1.03	1.23	-1.94	1.25
Erotic	-0.94	0.57	-1.22	1.34	-0.75	1.21	-1.73	0.97
Disgust	-0.85	0.78	-0.92	1.26	-1.18	1.17	-1.39	1.43
Pz								
Neutral	0.99	1.54	0.11	2.61	0.66	1.95	-1.03	2.45
Violent	1.10	1.44	0.25	2.21	0.65	1.50	-1.05	2.32
Erotic	-0.15	1.86	0.78	1.08	0.91	2.29	-0.78	1.45
Disgust	0.48	1.49	0.27	1.85	0.62	1.99	0.35	3.06

5.5.1.2 150 – 250ms Post Stimuli (200ms)

Table 75. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 200ms timeframe.

200ms	High Aggression Females (n=9)		High Aggression Males (n=12)		Low Aggression Females (n=21)		Low Aggression Males (n=34)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-3.44	2.34	-0.21	2.42	-3.47	3.66	-2.63	3.25
Violent	-2.47	2.09	0.92	1.92	-2.08	3.61	-2.50	4.09
Erotic	1.35	2.87	2.55	3.38	0.62	4.64	0.42	4.23
Disgust	-1.96	1.69	0.79	2.71	-2.84	3.14	-2.04	3.84
Fcz								
Neutral	-3.42	1.62	-0.88	1.76	-3.22	3.19	-2.93	2.93
Violent	-3.22	1.32	0.44	1.79	-2.46	2.87	-2.95	3.96
Erotic	0.27	2.05	2.34	3.00	-0.05	3.63	-0.28	3.81
Disgust	-2.38	1.31	0.32	2.76	-2.76	2.92	-2.33	3.58
Cz								
Neutral	0.03	2.64	-1.22	1.88	-0.06	1.78	-2.14	3.33
Violent	0.03	3.65	-0.67	2.75	-0.66	1.49	-3.56	3.86

Erotic	0.08	1.12	1.56	2.47	0.07	2.00	-0.83	2.96
Disgust	0.25	1.90	0.02	2.66	-0.63	1.35	-1.69	3.69
Pz								
Neutral	3.63	2.86	2.02	2.62	3.34	3.26	0.58	2.59
Violent	3.37	3.82	0.66	2.85	2.74	2.65	-0.96	2.54
Erotic	0.83	2.97	1.92	1.68	2.08	2.48	-0.63	2.45
Disgust	2.91	2.88	0.87	4.27	2.43	2.99	0.82	2.78

5.5.1.3 250 – 450ms Post Stimuli (300ms)

Table 76. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 300ms timeframe.

300ms	High Aggression Females (n=9)		High Aggression Males (n=12)		Low Aggression Females (n=21)		Low Aggression Males (n=34)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-2.07	3.31	-1.01	2.64	-2.14	3.67	-1.75	3.33
Violent	-1.60	4.17	0.66	4.61	-0.07	4.17	-1.42	5.41
Erotic	-0.06	5.12	0.77	4.43	0.51	5.77	0.87	3.46
Disgust	-3.28	2.80	-0.97	2.78	-1.75	4.27	-1.51	2.95
Fcz								
Neutral	-3.00	2.31	-1.79	2.15	-2.67	3.12	-2.58	3.10
Violent	-3.14	2.61	-0.13	3.92	-1.23	3.39	-2.27	5.49
Erotic	-1.30	3.77	0.42	3.27	-0.48	4.62	-0.27	3.19
Disgust	-4.00	2.16	-1.18	2.79	-2.40	3.67	-2.22	2.77
Cz								
Neutral	-1.18	2.07	-1.44	2.80	-1.56	1.93	-2.73	3.40
Violent	0.24	4.36	-1.23	3.26	-0.94	2.00	-3.44	4.20
Erotic	-0.68	2.03	0.43	2.12	-0.24	2.50	-0.94	3.21

Disgust	-0.61	2.94	-1.03	3.52	-0.93	2.02	-1.91	3.03
Pz								
Neutral	2.21	2.07	2.87	2.18	2.12	2.67	-0.05	2.53
Violent	4.51	4.27	2.46	2.05	3.10	2.78	-0.13	3.58
Erotic	2.13	2.31	4.72	2.70	3.28	3.41	1.20	2.91
Disgust	3.55	2.65	3.34	3.82	3.39	3.23	2.08	3.94

5.5.1.4 450 – 650ms Post Stimuli (ELPP)

Table 77. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the ELPP timeframe.

ELPP	High Aggression Females (n=9)		High Aggression Males (n=12)		Low Aggression Females (n=21)		Low Aggression Males (n=34)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.80	3.51	-0.51	3.22	-0.78	3.41	-1.00	3.07
Violent	-1.25	4.16	-0.80	4.44	0.58	3.46	-1.47	4.48
Erotic	-3.31	5.47	-3.16	5.37	-1.26	7.12	-2.55	5.40
Disgust	-3.83	3.07	-1.58	2.28	-1.45	4.49	-3.08	4.71
Fcz								
Neutral	-2.48	2.51	-1.33	2.57	-1.26	2.80	-1.69	2.95
Violent	-2.37	2.49	-1.21	3.97	-0.25	2.80	-1.99	4.50
Erotic	-3.68	4.08	-2.73	5.18	-1.19	5.50	-2.82	4.67
Disgust	-3.91	2.40	-1.25	2.40	-1.55	3.57	-3.27	4.03
Cz								
Neutral	-0.75	1.96	-0.31	2.45	-0.24	1.40	-1.09	2.93
Violent	1.58	5.45	-0.51	2.53	0.36	1.68	-1.30	3.30
Erotic	-0.72	2.76	0.16	2.72	1.64	2.52	-0.16	2.94
Disgust	0.01	2.89	-0.75	3.12	1.14	2.38	-0.53	2.23

Pz								
Neutral	2.06	1.95	3.32	2.40	1.92	2.32	0.83	2.56
Violent	5.10	5.22	3.61	2.02	2.67	2.15	2.01	3.18
Erotic	2.45	2.11	6.37	2.30	3.93	3.89	3.30	2.83
Disgust	3.92	1.17	3.20	2.90	3.91	2.91	3.70	4.08

5.5.1.5 650 – 850ms Post Stimuli (LLPP)

Table 78. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the ELPP timeframe

LLPP	High Aggression Females (n=9)		High Aggression Males (n=12)		Low Aggression Females (n=21)		Low Aggression Males (n=34)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.68	2.33	-0.03	3.51	-0.01	2.78	-0.36	2.98
Violent	-0.69	2.94	-0.80	4.07	0.88	3.05	-1.05	3.09
Erotic	-3.74	5.32	-1.47	3.07	-1.02	6.57	-1.86	4.06
Disgust	-4.24	3.48	-1.10	1.75	-0.91	3.78	-2.35	3.84
Fcz								
Neutral	-1.86	1.70	-0.55	2.70	-0.32	2.32	-0.78	2.70
Violent	-1.41	1.78	-0.83	3.56	0.22	2.39	-1.17	3.00
Erotic	-3.80	4.27	-1.00	2.73	-0.76	5.32	-2.01	3.44
Disgust	-3.83	2.50	-0.91	2.19	-1.07	2.81	-2.26	3.20
Cz								
Neutral	-0.27	1.56	0.52	1.50	0.18	1.10	-0.26	2.28
Violent	2.45	4.92	0.26	2.32	0.43	1.61	-0.52	2.20
Erotic	-1.06	3.20	0.97	1.43	1.43	1.91	0.13	2.20
Disgust	0.39	3.01	-0.16	2.50	1.24	1.79	0.51	1.32
Pz								

Neutral	1.69	1.28	2.81	2.77	1.26	1.67	0.64	2.34
Violent	4.73	4.77	2.73	1.61	1.82	2.04	1.43	2.53
Erotic	0.85	2.59	4.59	1.46	2.54	2.89	1.92	1.88
Disgust	3.17	1.77	1.78	2.61	3.13	2.54	2.85	3.22

Differences were found across the 100ms epoch at the Fz (Disgust: $F(3,77) = 2.88$ $p=0.04$, *ηp2*= .09), Cz (Neutral: $F(3,77) = 4.3$ $p=0.01$, *ηp2*= .14 ; Erotic: $F(3,77) = 3.68$ $p=0.02$, *ηp2*= .11) and Pz (Neutral: $F(3,77) = 3.29$ $p=0.03$, *ηp2*= .12; Violent: $F(3,77) = 4.64$ $p=0.01$, *ηp2*= .13 ; Erotic: $F(3,77) = 4.18$ $p=0.01$, *ηp2*=.13) measurement sites however, post hoc tests (Bonferroni correction) demonstrated that that the majority of differences were between LAM and LAF groups (see Appendix L for p values) and therefore could provide evidence for sex differences in early processing.

Across the 200ms epoch there were differences found for Fz (Neutral: $F(3,77) = 3.15$ $p=0.03$, *ηp2*=.10; Violent: $F(3,77) = 3.02$ $p=0.04$, *ηp2*=0.09; Disgust: $F(3,77) = 3.84$ $p=0.01$, *ηp2*=.12), Fcz (Violent: $F(3,77) = 4.01$ $p=0.01$, *ηp2*=.12; Disgust: $F(3,77) = 3.26$ $p=0.03$, *ηp2*=.10), Cz (Neutral: $F(3,77) = 3.8$ $p=0.01$, *ηp2*=.12; Violent: $F(3,77) = 6.27$ $p<0.01$, *ηp2*=.17; Erotic: $F(3,77) = 2.77$ $p=0.05$, *ηp2*=.09) and Pz (Neutral: $F(3,77) = 4.67$ $p<0.01$, *ηp2*=.16; Violent: $F(3,77) = 9.78$ $p<0.01$, *ηp2*=.22; Erotic: $F(3,77) = 6.22$ $p<0.01$, *ηp2*=.20) measurement sites however, post hoc tests (Bonferroni correction) demonstrated that across the 18 significant differences, the majority (n=13) were between HAM/LAF or LAF/LAM groups (see Appendix L for p values) and therefore could provide evidence for sex differences in early processing. However, in both frontal regions and over the central site there were significant differences found between HAM/LAM towards violent images and between HAM/LAM groups at the central and parietal sites for erotic images. This demonstrated that over the 200ms epoch there was within-sex (males only) evidence of differences in response that was moderated by total trait aggression scores. For violent images, LAM group responded with significantly increased negative amplitude in comparison to the HAM group whereas, in response to erotic images the HAM group responded with a significantly increased positive activation in comparison to the LAM group (see Table 62).

Across the 300ms epoch there were differences at the Cz (Violent: $F(3,77) = 3.91$ $p=0.01$, *ηp2*=.12) and Pz (Neutral: $F(3,77) = 5.06$ $p<0.01$, *ηp2*=.15; Violent: $F(3,77) = 6.82$ $p<0.01$, *ηp2*=.18; Erotic: $F(3,77) = 4.09$ $p=0.01$, *ηp2*=.12) measurement sites. Post hoc tests (Bonferroni correction) demonstrated that across the 8 significant differences, the majority (n=6) were between HAM/LAF or LAF/LAM groups (see Appendix L for p values) and could simply demonstrate evidence for sex differences in early processing. However, over the parietal region there were significant differences found between HAM/LAM towards neutral and erotic images. This demonstrated that over the 300ms epoch there was within-sex (males only) evidence of differences in response that was moderated by total trait aggression scores. For both neutral and erotic image categories, the HAM group responded with significantly increased positive amplitude in comparison to the LAM group.

Across the ELPP epoch there were differences at the Cz (Erotic: $F(3,77) = 3.09$ $p=0.03$, $\eta p2=.10$; Disgust: $F(3,77) = 2.8$ $p=0.05$, $\eta p2=.09$) and Pz (Neutral: $F(3,77) = 3$ $p=0.04$, $\eta p2=.10$; Erotic: $F(3,77) = 3.22$ $p=0.03$, $\eta p2=.11$) measurement sites. Post hoc tests (Bonferroni correction) demonstrated that across the significant differences, all were between HAM/LAF or LAF/LAM groups (see Appendix L for p values) and therefore could demonstrate evidence for sex differences in processing over the ELPP epoch (see Table 64).

Over the LLPP epoch there were differences at the Fcz (Disgust: $F(3,77) = 2.89$ $p=0.04$), Cz (Violent: $F(3,77) = 3.2$ $p=0.03$; Erotic: $F(3,77) = 4.07$ $p=0.01$) and Pz (Neutral: $F(3,77) = 3.06$ $p=0.03$, $\eta p2=.10$; Violent: $F(3,77) = 4.02$ $p=0.01$, $\eta p2=.11$; Erotic: $F(3,77) = 4.88$ $p<0.01$, $\eta p2=.15$) measurement sites. Post hoc tests (Bonferroni correction) revealed that across the 7 significant differences, the majority (n=5) were between HAM/LAF or LAF/LAM groups (see Appendix L for p values) and could demonstrate evidence for sex differences in processing. However, over the parietal region there were significant differences found between HAF/LAF towards violent content and between HAM/LAM towards erotic content. This could demonstrate that over the LLPP epoch there was within-sex evidence of differences in response that was moderated by total trait aggression scores. For the violent category, HAF responded with a significantly increased ($p=0.02$, $d=0.79$) positive ERP amplitude in comparison to those in the LAF group and for the erotic image content, the HAM group responded with significantly increased ($p=0.02$, $d=1.57$) positive amplitude in comparison to the LAM groups (see Table 65). This showed that those in high aggression groups responded with a significantly increased positive amplitude in comparison to those in the low aggression groups. A visual representation has been provided using ERP waveforms below (see Figure 126 - 143).

Neutral
Violent
Erotic
Disgust

Males

High Aggression

Low Aggression

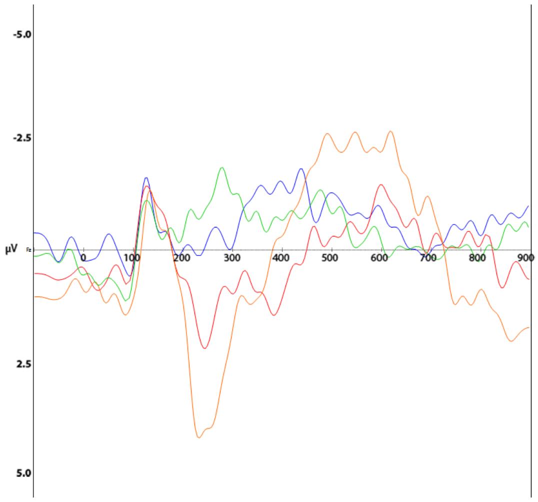


Figure 126. Grand average ERP waveform (microvolts) for HAM at the Fz location, across time (milliseconds).

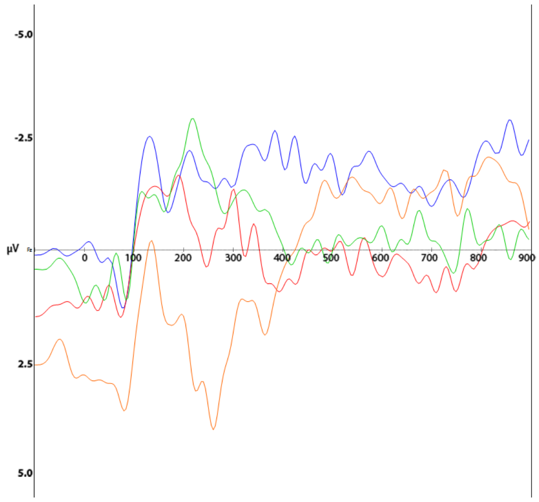


Figure 127. Grand average ERP waveform (microvolts) for LAM at the Fz location, across time (milliseconds).

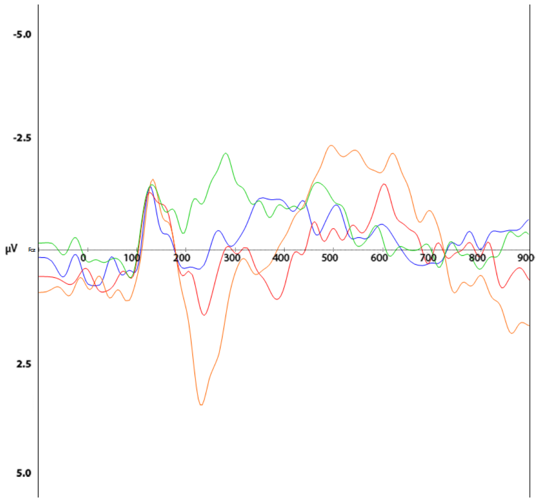


Figure 128. Grand average ERP waveform (microvolts) for HAM at the Fcz location, across time (milliseconds).

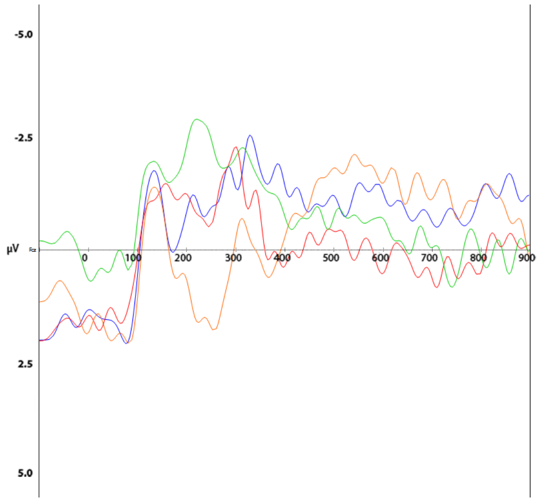


Figure 129. Grand average ERP waveform (microvolts) for LAM at the Fcz location, across time (milliseconds).

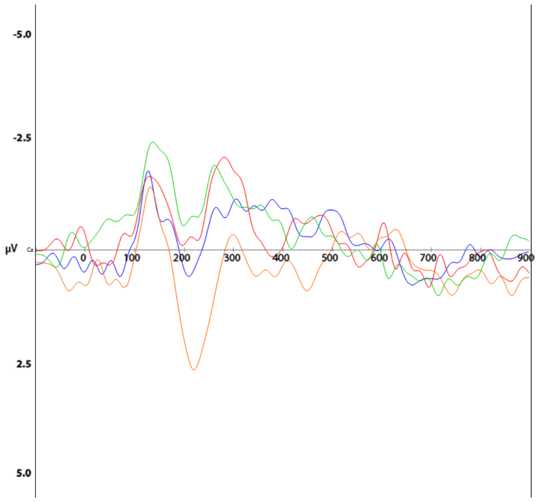


Figure 130. Grand average ERP waveform (microvolts) for HAM at the Cz location, across time (milliseconds).

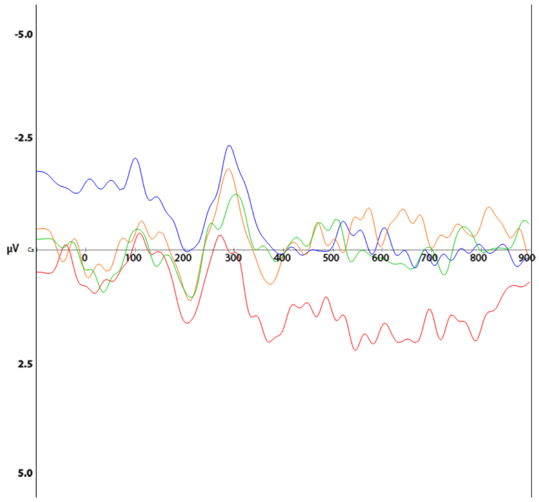


Figure 131. Grand average ERP waveform (microvolts) for LAM at the Cz location, across time (milliseconds).

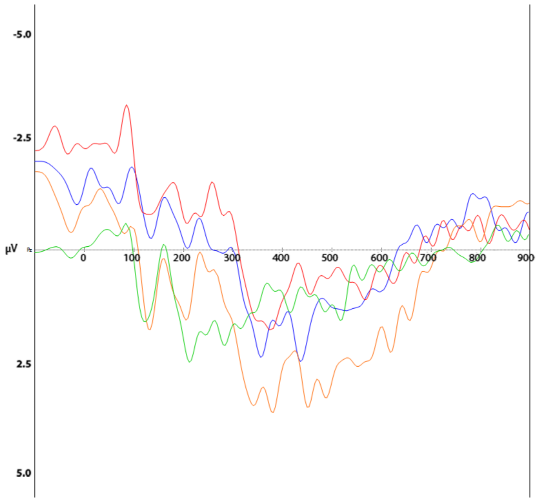


Figure 132. Grand average ERP waveform (microvolts) for HAM at the Pz location, across time (milliseconds).

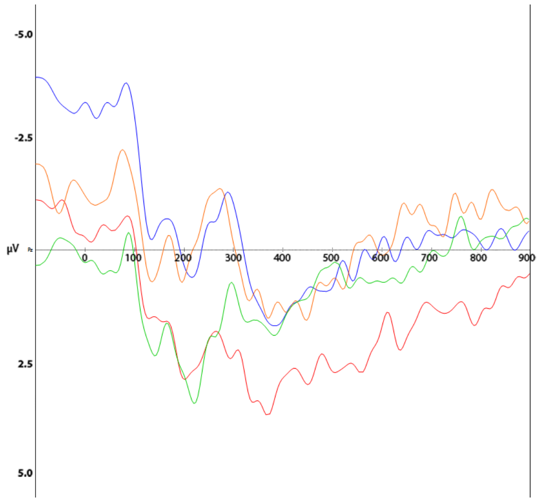


Figure 133. Grand average ERP waveform (microvolts) for LAM at the Pz location, across time (milliseconds).

Neutral
Violent
Erotic
Disgust

Females

High Aggression

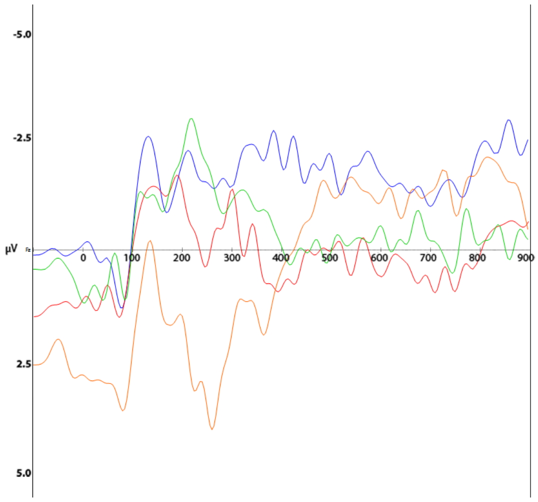


Figure 134. Grand average ERP waveform (microvolts) for HAF at the Fz location, across time (milliseconds).

Low Aggression

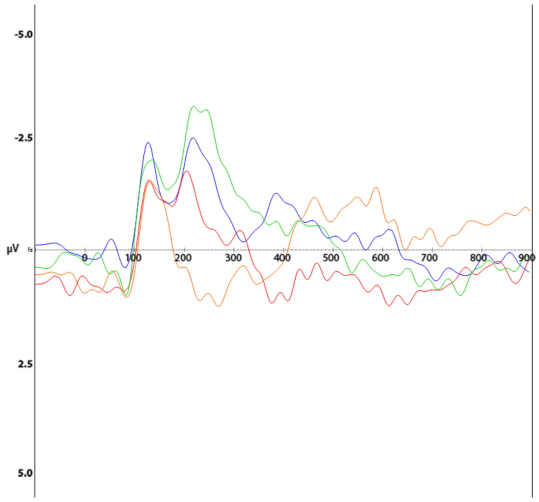


Figure 135. Grand average ERP waveform (microvolts) for LAF at the Fz location, across time (milliseconds).

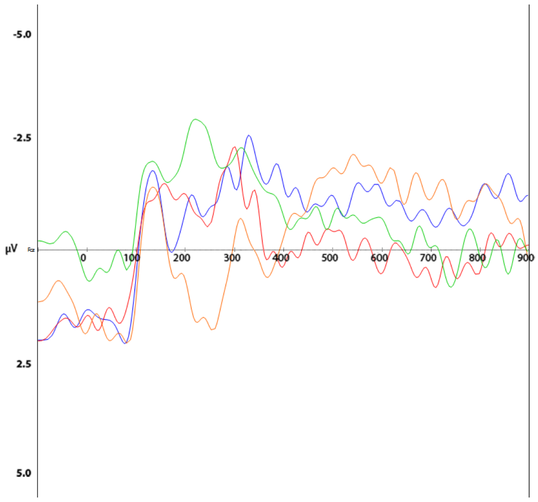


Figure 136. Grand average ERP waveform (microvolts) for HAF at the Fcz location, across time (milliseconds).

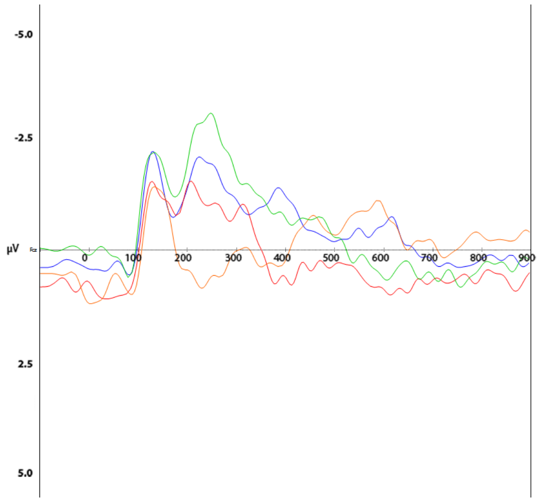


Figure 137. Grand average ERP waveform (microvolts) for LAF at the Fcz location, across time (milliseconds).

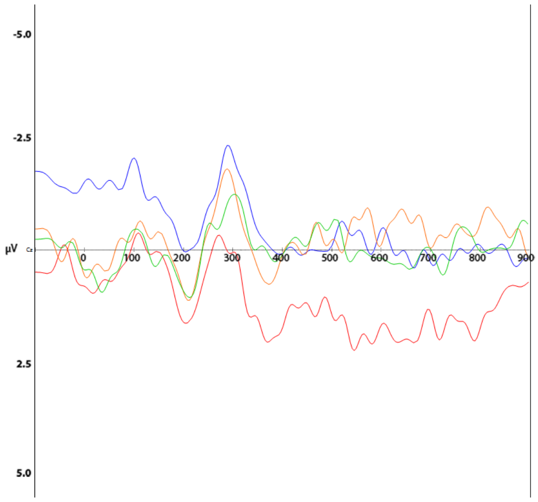


Figure 138. Grand average ERP waveform (microvolts) for HAF at the Cz location, across time (milliseconds).

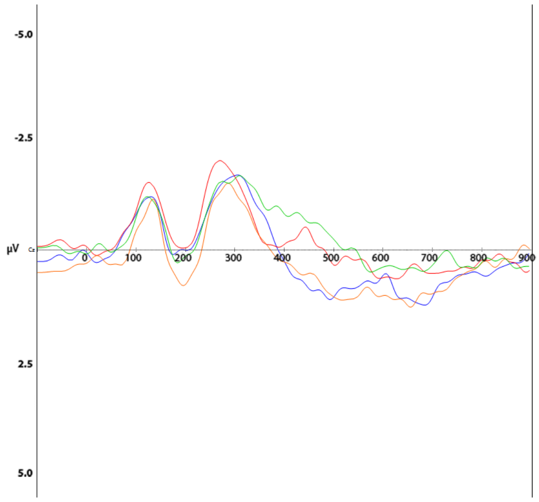


Figure 139. Grand average ERP waveform (microvolts) for LAF at the Cz location, across time (milliseconds).

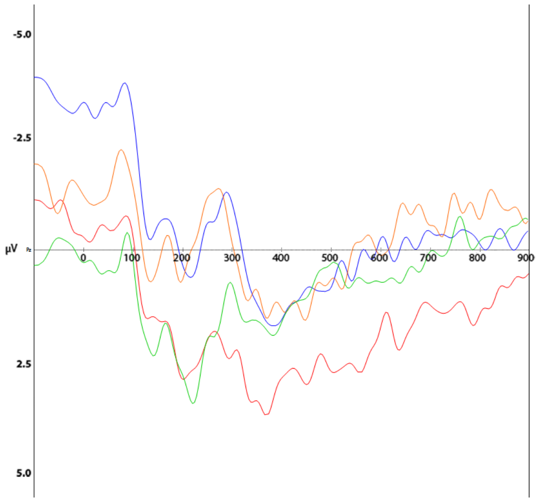


Figure 140. Grand average ERP waveform (microvolts) for HAF at the Pz location, across time (milliseconds).

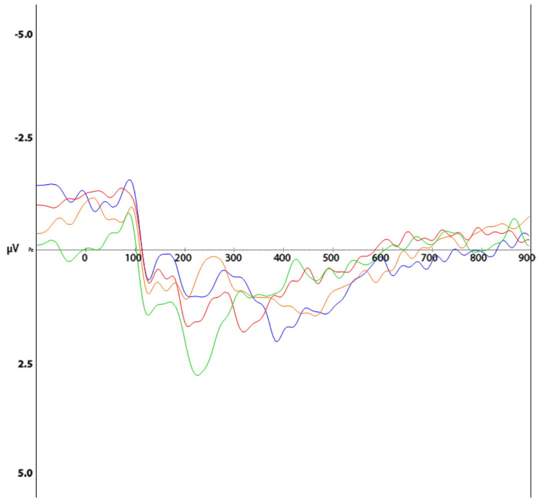


Figure 141. Grand average ERP waveform (microvolts) for LAF at the Pz location, across time (milliseconds).

5.5.2 Method 2: Trait Aggression (Data Median - Overall and Within-Sex)

This section analysed mean ERP amplitude by location and epoch to affective images based on using the data median (overall and then within sex) to define the divide for high or low aggression scores on the Buss and Perry (1992) Aggression Questionnaire.

5.5.2.1 Overall Descriptive Data

The overall data median was 73. Descriptive statistics have been provided in the below succession of tables for mean ERP amplitude in response to image (see Tables 79 - 83). Total aggression score means and standard deviations were similar across high (HAF mean=81.82, SD=9.24; HAM mean=82.21, SD=8.03) and low scoring groups (LAF mean= 55.96, SD=12.58; LAM mean=54.91, SD=10.32) however, standard deviations were larger for the low scoring groups in comparison to the high scoring groups demonstrating a larger variance around the mean value. As predicted, there were significant differences in response towards affective imagery between high and low trait aggression scoring groups (see Appendix M and N for full tabulated inferential statistics).

5.5.2.2 50 – 150ms Post Stimuli (100ms)

Table 79. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 100ms timeframe.

100ms	High Aggression Females (n=17)		High Aggression Males (n=24)		Low Aggression Females (n=26)		Low Aggression Males (n=11)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.22	2.03	0.15	2.15	-1.35	1.96	-1.05	1.80
Violent	-1.64	1.76	-1.06	1.38	-1.49	1.78	-1.61	1.82
Erotic	-0.36	2.48	-1.00	2.37	-1.30	2.50	-2.28	1.98
Disgust	-0.70	1.82	-0.40	1.38	-1.90	1.70	-0.53	1.54
Fcz								
Neutral	-1.43	1.76	-0.42	1.51	-1.59	1.73	-1.59	1.42
Violent	-1.94	1.58	-1.14	1.39	-1.52	1.51	-1.99	1.32
Erotic	-0.94	1.87	-1.13	2.01	-1.33	1.99	-2.41	1.89
Disgust	-1.09	1.54	-0.81	1.13	-2.03	1.60	-1.18	1.75
Cz								
Neutral	-0.82	0.91	-1.87	1.41	-0.72	1.41	-1.71	1.35

Violent	-1.13	1.46	-1.42	1.60	-0.89	1.34	-2.23	0.80
Erotic	-0.93	0.49	-1.49	1.20	-0.70	1.36	-1.69	0.95
Disgust	-1.00	0.79	-1.27	1.17	-1.19	1.28	-1.15	1.80
Pz								
Neutral	0.69	1.95	-0.88	2.28	0.76	1.84	-0.09	3.05
Violent	0.74	1.26	-0.34	1.99	0.75	1.64	-1.18	2.98
Erotic	-0.10	2.50	-0.15	1.56	1.20	1.91	-0.46	1.46
Disgust	0.63	1.55	0.05	2.48	0.56	2.10	0.93	3.10

5.5.2.3 150 – 250ms Post Stimuli (200ms)

Table 80. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 200ms timeframe.

200ms	High Aggression Females (n=17)		High Aggression Males (n=24)		Low Aggression Females (n=26)		Low Aggression Males (n=11)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-3.58	2.88	-1.83	3.50	-3.40	3.76	-1.73	2.49
Violent	-2.94	1.94	-0.89	4.04	-1.65	3.95	-2.29	3.32
Erotic	0.82	3.18	1.81	4.67	0.74	4.97	-0.29	1.45
Disgust	-2.20	2.60	-0.97	4.27	-2.96	3.10	-1.28	2.17
Fcz								
Neutral	-3.41	2.29	-2.26	3.03	-3.16	3.30	-2.16	2.11
Violent	-3.32	1.33	-1.34	3.90	-2.16	3.15	-2.78	3.25
Erotic	-0.07	2.58	1.38	4.19	0.08	3.80	-1.05	1.56
Disgust	-2.33	2.14	-1.31	4.02	-2.92	2.96	-1.67	2.20
Cz								
Neutral	-0.57	2.14	-2.30	3.11	0.31	1.77	-0.78	2.21
Violent	-0.51	2.79	-2.42	4.28	-0.53	1.52	-2.89	2.31

Erotic	-0.32	1.45	0.27	3.56	0.34	2.04	-0.62	0.91
Disgust	-0.28	1.65	-1.28	3.79	-0.55	1.42	-0.72	2.61
Pz								
Neutral	3.49	3.11	0.85	2.75	3.34	3.24	1.56	2.50
Violent	3.65	3.35	-0.21	2.45	2.36	2.49	-0.83	3.33
Erotic	1.16	3.03	0.55	2.69	2.25	2.23	-0.41	2.03
Disgust	3.30	2.51	0.35	3.71	2.02	3.13	1.89	1.91

5.5.2.4 250 – 450ms Post Stimuli (300ms)

Table 81. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 300ms timeframe.

300ms	High Aggression Females (n=17)		High Aggression Males (n=24)		Low Aggression Females (n=26)		Low Aggression Males (n=11)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-2.27	3.39	-1.88	2.90	-2.04	3.73	-0.67	3.46
Violent	-1.10	3.27	-0.95	4.88	0.07	4.67	-0.18	5.99
Erotic	0.11	4.73	0.34	4.21	0.58	6.16	1.93	2.29
Disgust	-1.83	3.37	-1.75	3.05	-2.22	4.46	-0.42	2.27
Fcz								
Neutral	-2.92	2.68	-2.61	2.49	-2.63	3.16	-1.67	3.45
Violent	-2.20	2.40	-1.69	4.41	-1.26	3.79	-1.22	6.47
Erotic	-0.90	3.73	-0.24	3.40	-0.50	4.89	0.41	2.74
Disgust	-2.64	2.57	-2.00	2.81	-2.79	3.97	-1.57	2.82
Cz								
Neutral	-1.94	2.02	-2.70	3.01	-1.18	1.86	-1.37	3.63

Violent	-0.73	3.34	-2.58	3.53	-0.67	2.14	-2.90	5.06
Erotic	-1.01	1.82	-0.38	3.11	0.11	2.64	-0.68	2.62
Disgust	-1.06	2.24	-1.50	3.19	-0.73	2.22	-1.84	3.32
Pz								
Neutral	2.13	2.47	1.21	2.87	2.15	2.62	0.40	2.55
Violent	3.92	3.63	1.60	2.76	3.05	2.80	-1.08	3.89
Erotic	1.93	3.91	3.17	3.35	3.76	2.49	0.74	2.48
Disgust	3.87	2.67	3.15	4.24	3.13	3.35	1.12	2.65

5.5.2.5 450 – 650ms Post Stimuli (ELPP)

Table 82. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the ELPP timeframe.

ELPP	High Aggression Females (n=17)		High Aggression Males (n=24)		Low Aggression Females (n=26)		Low Aggression Males (n=11)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.90	3.47	-1.31	3.12	-0.40	3.31	0.22	2.85
Violent	-0.18	3.55	-1.72	4.28	0.44	3.75	-0.18	4.71
Erotic	-2.17	6.64	-3.79	6.04	-1.37	7.01	-0.51	2.04
Disgust	-1.90	4.58	-3.45	4.54	-1.98	4.22	-0.63	1.67
Fcz								
Neutral	-2.30	2.73	-1.96	2.72	-0.99	2.71	-0.70	2.88
Violent	-1.08	2.54	-2.04	3.97	-0.45	3.05	-1.04	5.03
Erotic	-2.47	4.94	-3.46	5.53	-1.21	5.55	-1.33	1.95
Disgust	-2.23	3.22	-3.16	4.13	-1.92	3.68	-1.32	1.89
Cz								
Neutral	-0.88	1.59	-1.26	2.54	0.00	1.40	0.15	3.11
Violent	0.72	4.00	-0.68	2.58	0.55	1.85	-1.80	3.90

Erotic	-0.14	2.48	0.08	3.07	1.99	2.57	-0.35	2.31
Disgust	0.47	2.35	-0.82	2.63	1.19	2.60	-0.13	2.32
Pz								
Neutral	2.22	2.23	1.93	2.60	1.77	2.24	1.14	3.09
Violent	3.82	4.27	3.58	2.35	2.76	2.09	0.32	2.84
Erotic	2.07	4.75	5.65	2.46	4.63	2.21	1.53	2.08
Disgust	4.37	2.25	4.12	3.84	3.61	2.86	2.25	3.08

5.5.2.6 650 – 850ms Post Stimuli (LLPP)

Table 83. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the LLPP timeframe.

LLPP	High Aggression Females (n=17)		High Aggression Males (n=24)		Low Aggression Females (n=26)		Low Aggression Males (n=11)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.11	2.71	-0.68	3.55	0.13	2.72	0.70	1.67
Violent	0.36	3.24	-1.32	3.31	0.68	3.00	-0.19	3.63
Erotic	-2.45	6.57	-2.38	3.77	-1.02	6.30	-0.29	3.27
Disgust	-1.66	5.12	-2.49	3.73	-1.57	3.02	-0.67	1.61
Fcz								
Neutral	-1.23	2.30	-1.05	3.00	-0.26	2.22	0.05	1.61
Violent	-0.44	2.20	-1.32	2.97	0.09	2.47	-0.46	3.60
Erotic	-2.49	4.93	-2.05	3.43	-0.68	5.38	-0.82	2.61
Disgust	-1.82	3.53	-2.12	3.31	-1.53	2.57	-1.10	1.80
Cz								
Neutral	-0.11	1.35	-0.30	1.99	0.21	1.10	0.67	2.13
Violent	1.34	3.72	-0.05	1.96	0.53	1.79	-0.70	2.81
Erotic	-0.08	2.67	0.59	1.58	1.55	2.04	0.05	2.73
Disgust	1.10	2.40	0.23	1.88	1.03	1.91	0.40	1.71

Pz								
Neutral	1.80	1.31	1.45	2.43	1.05	1.71	1.25	3.25
Violent	3.20	4.09	2.53	1.81	1.93	1.96	0.44	2.72
Erotic	1.05	3.62	3.78	1.70	2.93	2.03	0.77	1.53
Disgust	3.63	2.54	2.74	3.06	2.82	2.26	1.91	3.02

Significant differences were found over the 100ms epoch at the Fz (Disgust: $F(3,77) = 4.31$ $p=0.01$, $\eta p2=.13$), Fcz (Disgust: $F(3,77) = 3.09$ $p=0.03$, $\eta p2=.12$), Cz (Neutral: $F(3,77) = 4.22$ $p=0.01$, $\eta p2=.13$; Erotic: $F(3,77) = 3.22$ $p=0.03$, $\eta p2=.10$) and Pz (Neutral: $F(3,77) = 2.81$ $p=0.05$, $\eta p2=.11$; Violent: $F(3,77) = 3.63$ $p=0.02$, $\eta p2=.10$; Erotic: $F(3,77) = 3.22$ $p=0.03$, $\eta p2=.10$) measurement sites across the 100ms epoch. Post hoc tests (Bonferroni correction) revealed that all 4 significant differences were found between HAM/LAF or LAF/LAM groups (see Appendix N for p values). It could therefore be argued that these data demonstrate evidence for sex differences in processing rather than an effect moderated by trait aggression score.

Over the 200ms epoch, significant differences were found at the Cz (Neutral: $F(3,77) = 5.04$ $p<0.01$, $\eta p2=.15$; Violent: $F(3,77) = 3.1$ $p=0.03$, $\eta p2=.10$) and Pz (Neutral: $F(3,77) = 4.08$ $p=0.01$, $\eta p2=.14$; Violent: $F(3,77) = 9.57$ $p<0.01$, $\eta p2=.20$; Erotic: $F(3,77) = 3.43$ $p=0.02$, $\eta p2=.14$; Disgust: $F(3,77) = 3.17$ $p=0.03$, $\eta p2=.12$) measurement sites across the 200ms epoch. Post hoc tests (Bonferroni correction) revealed a similar pattern to the 100ms epoch where all 8 significant differences were found between different sex groups i.e. LAM/LAF, HAM/LAF, HAM/HAF (see Appendix N for p values). There was no consistency for between sex (i.e. differences between groups HAM/LAM or HAF/LAF) groups. It could therefore be argued that these results demonstrate evidence for sex differences in processing rather than an effect moderated by trait aggression scores.

Across the 300ms epoch, significant differences were found at the Pz (Violent: $F(3,77) = 6.58$ $p<0.01$, $\eta p2=.16$; Erotic: $F(3,77) = 2.98$ $p=0.04$, $\eta p2=.12$) measurement site for the 300ms epoch. Post hoc tests (Bonferroni correction) revealed a similar pattern to both previous epochs, all significant differences were found between different sex groups i.e. LAM/ HAF, LAM/LAF, HAM/LAF, HAM/HAF (see Appendix N for p values). There was no consistency for between sex (i.e. differences between groups HAM/LAM or HAF/LAF) groups. It could therefore be argued that these results demonstrate evidence for sex differences in processing rather than an effect moderated by trait aggression scores.

Over the ELPP epoch there were differences found at the Cz (Erotic: $F(3,77) = 3.49$ $p=0.02$, $\eta p2=.11$; Disgust: $F(3,77) = 2.76$ $p=0.05$, $\eta p2=.09$) and Pz (Violent: $F(3,77) = 4.02$ $p=0.01$, $\eta p2=.12$; Erotic:

F(3,77) =7.63 p<0.01, $\eta p2$=.19) measurement sites. Post hoc tests (Bonferroni correction) revealed that across the 5 significant differences, the majority (n=3) were between HAM/LAF or HAF/HAM groups (see Appendix L for p values) and could demonstrate evidence for sex differences in processing. However, over the parietal region there were significant differences found between HAM/LAM towards violent (p=0.01, d=1.25) and erotic (p<0.01, d=1.81) content. This could demonstrate that over the LLPP epoch there was within-sex evidence of differences in response that was moderated by total trait aggression scores. For both categories, HAM responded with a significantly increased positive ERP amplitude in comparison to those in the LAM group (see Table 69.). This showed that those in high aggression groups responded with a significantly increased positive activation in comparison to those in the low aggression groups towards affective content.

Over the LLPP epoch there was one significant result found at the Pz site in response to erotic (F(3,77) =6.92 p<0.01, $\eta p2$=.18) images. However, post hoc (Bonferroni correction) test provided no significant results when multiple comparisons were accounted for with an alpha set at p=0.05. A visual representation of this data has been provided using ERP waveforms below (see Figure 142 - 157).

Males

High Aggression

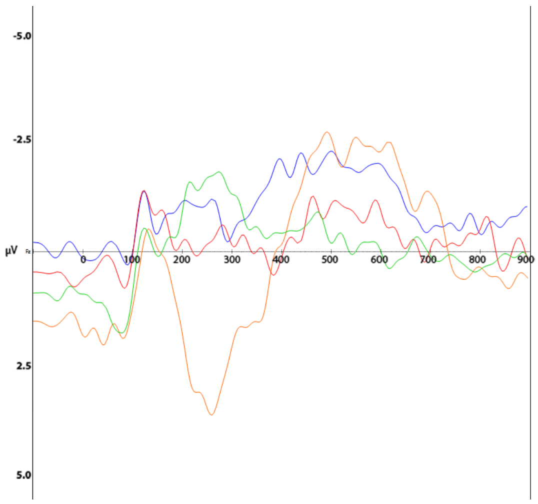


Figure 142. Grand average ERP waveform (microvolts) for HAM at the Fz location, across time (milliseconds).

Low Aggression

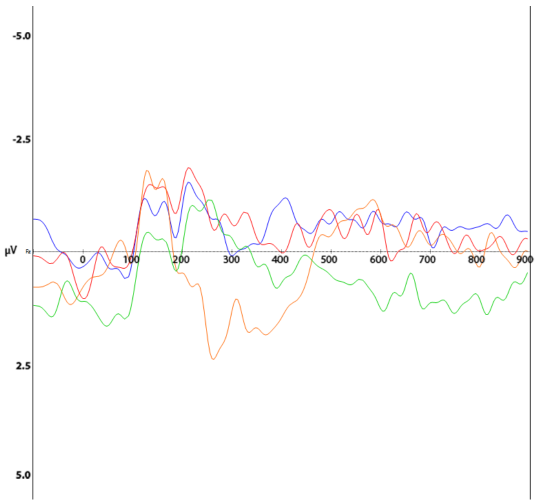


Figure 143. Grand average ERP waveform (microvolts) for LAM at the Fz location, across time (milliseconds).

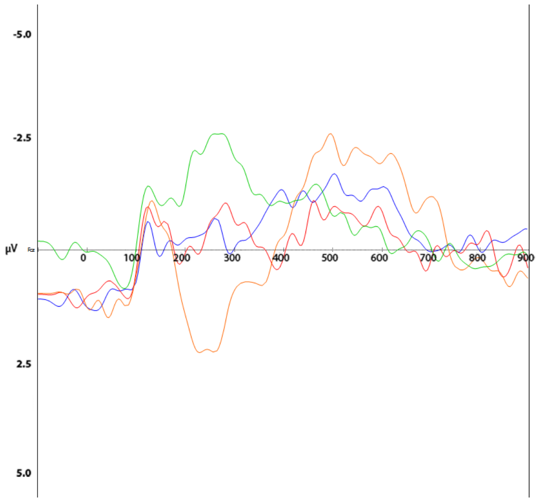


Figure 144. Grand average ERP waveform (microvolts) for HAM at the Fcz location, across time (milliseconds).

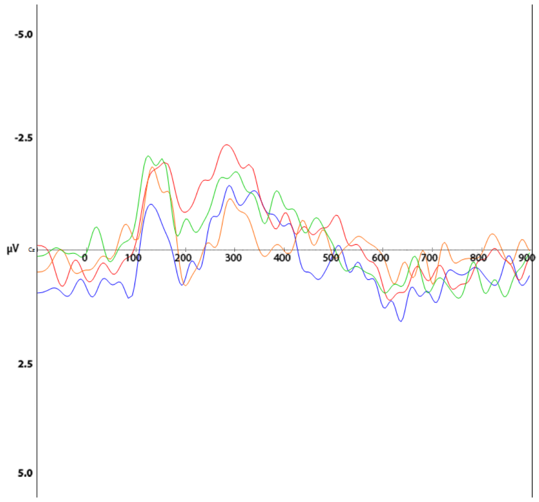


Figure 145. Grand average ERP waveform (microvolts) for LAM at the Fcz location, across time (milliseconds).

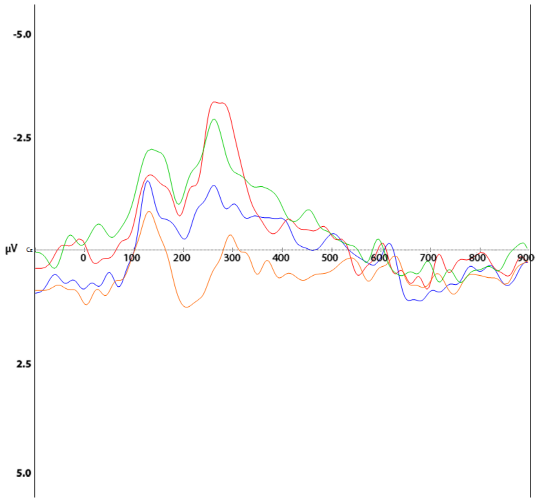


Figure 146. Grand average ERP waveform (microvolts) for HAM at the Cz location, across time (milliseconds).

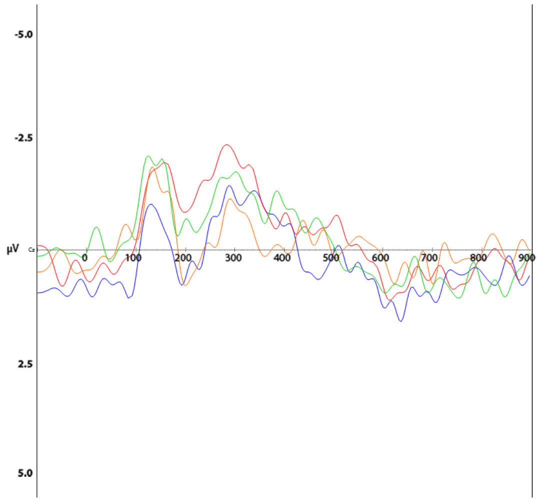
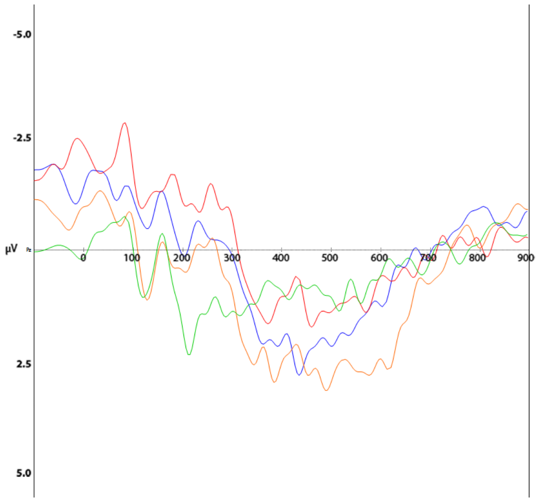


Figure 147. Grand average ERP waveform (microvolts) for LAM at the Cz location, across time (milliseconds).



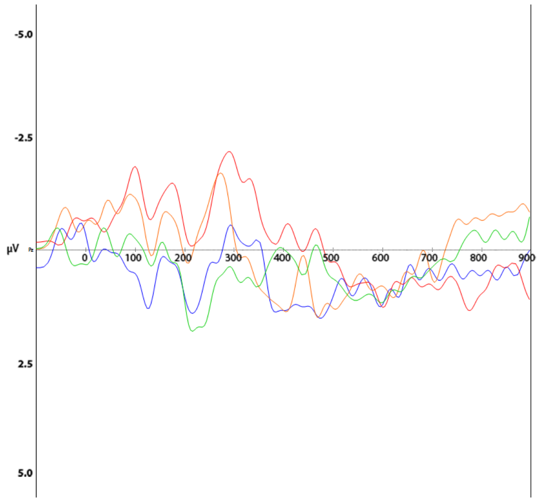


Figure 148. Grand average ERP waveform (microvolts) for HAM at the Pz location, across time (milliseconds).

Figure 149. Grand average ERP waveform (microvolts) for LAM at the Pz location, across time (milliseconds).

Females

High Aggression

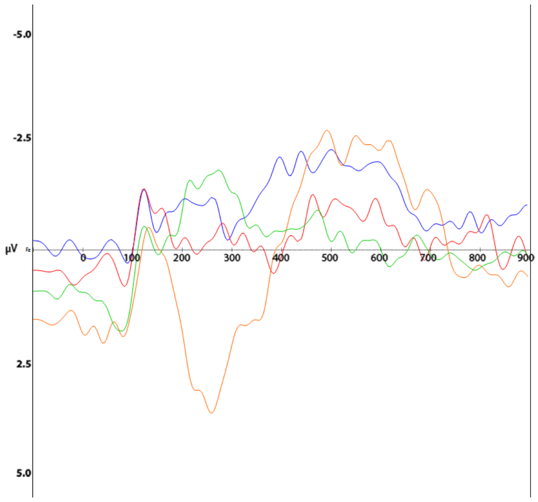


Figure 150. Grand average ERP waveform (microvolts) for HAF at the Fz location, across time (milliseconds).

Low Aggression

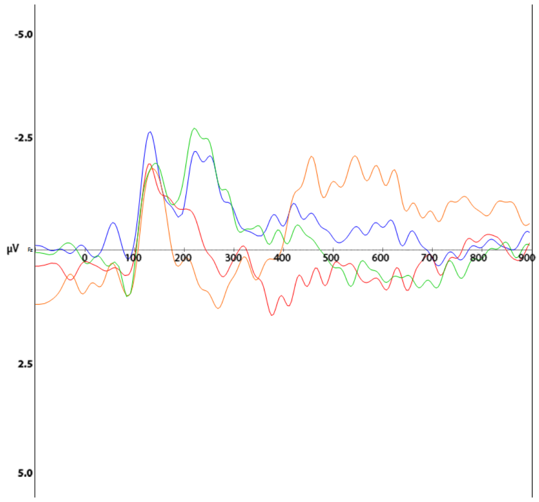


Figure 151. Grand average ERP waveform (microvolts) for LAF at the Fz location, across time (milliseconds).

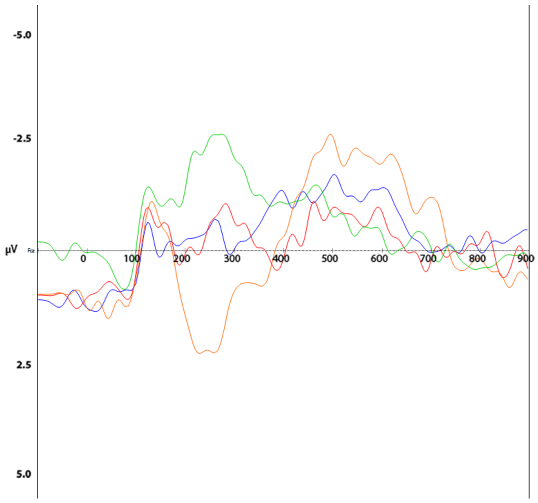


Figure 152. Grand average ERP waveform (microvolts) for HAF at the Fcz location, across time (milliseconds).

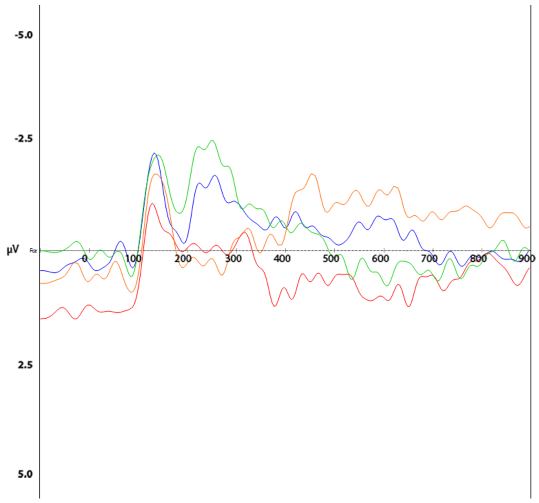


Figure 153. Grand average ERP waveform (microvolts) for LAF at the Fcz location, across time (milliseconds).

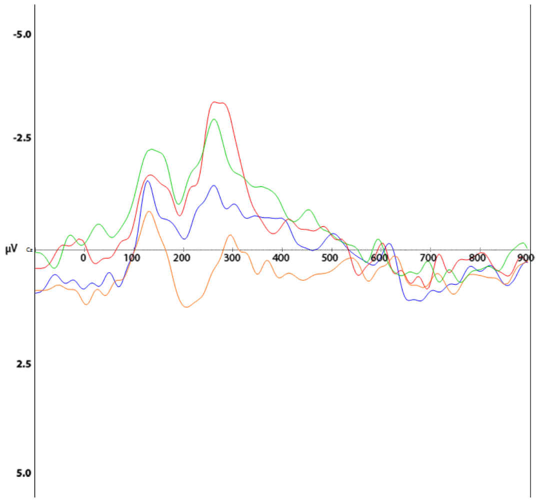


Figure 154. Grand average ERP waveform (microvolts) for HAF at the Cz location, across time (milliseconds).

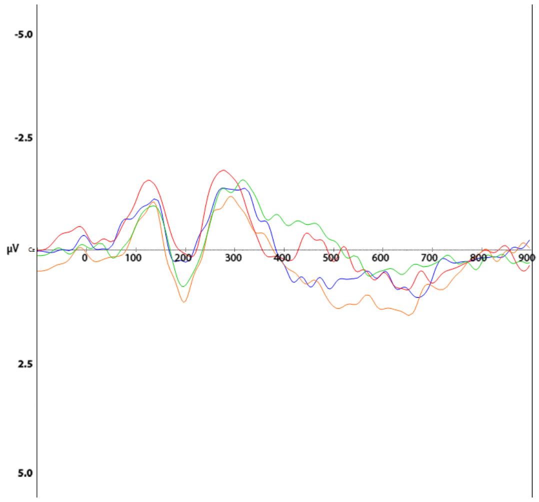


Figure 155. Grand average ERP waveform (microvolts) for LAF at the Cz location, across time (milliseconds).

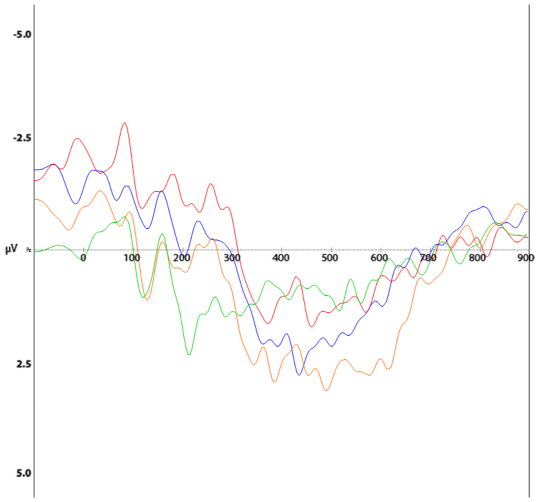


Figure 156. Grand average ERP waveform (microvolts) for HAF at the Pz location, across time (milliseconds).

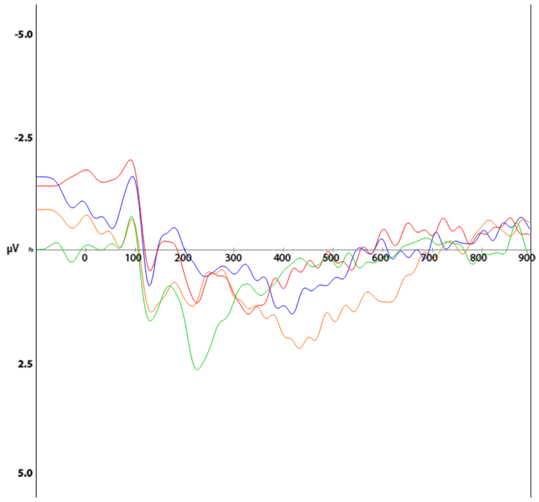


Figure 157. Grand average ERP waveform (microvolts) for LAF at the Pz location, across time (milliseconds).

5.5.2.7 Method 3: Within-Sex (Weighted) Descriptive Data

The following data tables (Tables 84-88) were collated using the within-sex median to define group criteria for high or low scores on the Buss and Perry (1992) Aggression Questionnaire by location and epoch to affective images. The overall median total aggression score was 73. The male median was 75 (SD=15.5) and the female median was 69 (SD=17.04). This score was a weighted by sex value. Descriptive statistics have been provided in the below succession of tables for mean ERP amplitude in response to image (see Tables 71-80). Total aggression score means and standard deviations were similar across high (HAF mean=88.67, SD=7.62; HAM mean=91.38, SD=6.91) and low groups (LAF mean=

42.2, SD=5.71; LAM mean=48.14, SD=4.26). As expected, there were significant differences found between high and low scoring groups in response to images, across epoch and location.

5.5.2.8 50 – 150ms Post Stimuli (100ms) Within-Sex

Table 84. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 100ms timeframe.

100ms	High Aggression Females (n=23)		High Aggression Males (n=22)		Low Aggression Females (n=20)		Low Aggression Males (n=13)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.44	2.02	0.14	2.18	-1.13	1.94	-0.86	1.87
Violent	-1.67	1.66	-1.21	1.32	-1.40	1.89	-1.27	1.89
Erotic	-0.57	2.44	-0.99	2.46	-1.34	2.58	-2.10	1.89
Disgust	-1.20	1.90	-0.38	1.30	-1.69	1.75	-0.54	1.63
Fcz								
Neutral	-1.65	1.79	-0.47	1.51	-1.39	1.67	-1.32	1.56
Violent	-1.86	1.47	-1.31	1.30	-1.47	1.62	-1.58	1.62
Erotic	-0.97	1.75	-1.03	2.06	-1.41	2.14	-2.40	1.74
Disgust	-1.55	1.63	-0.77	1.10	-1.78	1.65	-1.18	1.70
Cz								
Neutral	-0.61	0.95	-1.85	1.47	-0.94	1.49	-1.75	1.24
Violent	-0.79	1.49	-1.53	1.58	-1.21	1.23	-1.93	1.16
Erotic	-0.78	0.97	-1.35	1.14	-0.81	1.26	-1.91	1.02
Disgust	-1.00	0.85	-1.27	1.22	-1.25	1.35	-1.17	1.65
Pz								
Neutral	0.82	1.69	-0.76	2.35	0.63	2.08	-0.42	2.90
Violent	1.09	1.36	-0.37	2.08	0.34	1.55	-0.99	2.77
Erotic	0.32	2.54	-0.03	1.58	1.10	1.79	-0.61	1.38

Disgust	0.76	1.49	0.22	2.51	0.38	2.27	0.51	3.03

5.5.2.9 150 – 250ms Post Stimuli (200ms) Within-Sex

Table 85. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 200ms timeframe.

200ms	High Aggression Females (n=23)		High Aggression Males (n=22)		Low Aggression Females (n=20)		Low Aggression Males (n=13)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-4.15	2.83	-1.74	3.64	-2.69	3.89	-1.91	2.31
Violent	-3.13	1.73	-0.97	4.21	-1.05	4.32	-1.95	3.17
Erotic	1.22	3.31	1.90	4.88	0.25	5.28	-0.12	1.39
Disgust	-3.06	2.80	-0.97	4.39	-2.19	3.02	-1.23	2.28
Fcz								
Neutral	-3.96	2.27	-2.23	3.17	-2.45	3.39	-2.22	1.95
Violent	-3.61	1.32	-1.44	4.06	-1.48	3.27	-2.38	3.15
Erotic	0.29	2.80	1.49	4.37	-0.30	3.92	-0.86	1.50
Disgust	-3.19	2.48	-1.33	4.17	-2.10	2.79	-1.57	2.16
Cz								
Neutral	-0.24	2.14	-2.29	3.26	0.20	1.73	-1.02	2.10
Violent	-0.60	2.46	-2.61	4.41	-0.42	1.62	-2.50	2.37
Erotic	-0.18	1.96	0.33	3.71	0.37	1.70	-0.57	0.87
Disgust	-0.41	1.57	-1.39	3.94	-0.48	1.45	-0.63	2.40
Pz								
Neutral	3.73	2.89	0.99	2.84	3.02	3.47	1.23	2.42
Violent	3.53	2.90	-0.32	2.53	2.12	2.77	-0.54	3.13
Erotic	1.42	2.74	0.64	2.75	2.28	2.42	-0.41	1.97
Disgust	3.22	2.26	0.59	3.74	1.73	3.46	1.26	2.48

5.5.2.10 250 – 450ms Post Stimuli (300ms) Within-Sex

Table 86. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 300ms timeframe.

300ms	High Aggression Females (n=23)		High Aggression Males (n=22)		Low Aggression Females (n=20)		Low Aggression Males (n=13)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-2.77	3.23	-1.71	2.96	-1.39	3.86	-1.14	3.39
Violent	-1.18	2.97	-0.98	5.11	0.52	5.15	-0.25	5.47
Erotic	1.05	5.86	0.48	4.32	-0.37	5.30	1.44	2.55
Disgust	-2.72	3.35	-1.66	3.18	-1.33	4.67	-0.76	2.25
Fcz								
Neutral	-3.35	2.56	-2.46	2.55	-2.04	3.27	-2.05	3.29
Violent	-2.39	2.18	-1.68	4.61	-0.76	4.15	-1.31	5.92
Erotic	-0.14	4.60	-0.06	3.46	-1.24	4.25	0.00	2.79
Disgust	-3.42	2.60	-1.91	2.92	-1.94	4.15	-1.79	2.64
Cz								
Neutral	-1.62	1.95	-2.50	3.06	-1.32	1.96	-1.93	3.58
Violent	-0.77	3.09	-2.58	3.67	-0.61	2.08	-2.87	4.66
Erotic	-0.66	2.49	-0.12	3.13	0.05	2.27	-1.06	2.57
Disgust	-1.03	2.16	-1.42	3.26	-0.66	2.30	-1.92	3.15
Pz								
Neutral	2.35	2.28	1.39	2.91	1.91	2.84	0.21	2.43
Violent	3.85	3.20	1.67	2.88	2.87	3.07	-0.78	3.62
Erotic	2.30	3.43	3.41	3.35	3.88	2.81	0.70	2.38
Disgust	3.86	2.34	3.42	4.32	2.92	3.77	0.98	2.47

5.5.2.11450 – 650ms Post Stimuli (ELPP) Within-Sex

Table 87. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the ELPP timeframe.

ELPP	High Aggression Females (n=23)		High Aggression Males (n=22)		Low Aggression Females (n=20)		Low Aggression Males (n=13)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-2.00	3.15	-1.15	3.07	0.17	3.41	-0.29	3.16
Violent	-0.42	3.13	-1.78	4.44	0.91	4.12	-0.32	4.39
Erotic	-0.92	7.75	-3.62	6.08	-2.58	5.57	-1.31	3.45
Disgust	-2.49	4.09	-3.38	4.71	-1.32	4.58	-1.19	2.21
Fcz								
Neutral	-2.38	2.46	-1.81	2.63	-0.51	2.80	-1.14	3.11
Violent	-1.24	2.24	-2.07	4.10	-0.08	3.37	-1.13	4.69
Erotic	-1.37	6.04	-3.24	5.55	-2.10	4.40	-2.02	3.09
Disgust	-2.57	2.83	-3.02	4.24	-1.43	4.07	-1.83	2.31
Cz								
Neutral	-0.58	1.66	-1.15	2.58	-0.08	1.34	-0.27	3.07
Violent	0.71	3.64	-0.77	2.68	0.51	1.60	-1.46	3.65
Erotic	0.44	3.30	0.31	3.10	1.95	1.56	-0.67	2.28
Disgust	0.83	2.73	-0.78	2.75	0.99	2.28	-0.30	2.17
Pz								
Neutral	2.22	2.06	1.96	2.70	1.63	2.41	1.21	2.86
Violent	3.78	3.73	3.52	2.44	2.50	2.16	0.94	3.00
Erotic	2.59	4.20	5.87	2.42	4.80	2.41	1.79	2.05
Disgust	4.54	2.24	4.13	3.97	3.19	2.92	2.52	3.02

5.5.2.12 650 – 850ms Post Stimuli (LLPP) Within-Sex

Table 88. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the LLPP timeframe.

LLPP	High Aggression Females (n=23)		High Aggression Males (n=22)		Low Aggression Females (n=20)		Low Aggression Males (n=13)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.04	2.45	-0.62	3.66	0.41	2.93	0.39	1.87
Violent	0.59	3.10	-1.34	3.40	0.51	3.10	-0.33	3.44
Erotic	-0.68	7.68	-2.22	3.84	-2.63	4.40	-0.89	3.46
Disgust	-1.96	4.47	-2.32	3.85	-1.19	3.25	-1.24	2.05
Fcz								
Neutral	-1.16	2.03	-1.00	3.07	-0.05	2.45	-0.20	1.77
Violent	-0.17	2.15	-1.34	3.01	-0.06	2.62	-0.56	3.46
Erotic	-0.79	6.50	-1.80	3.41	-2.10	3.23	-1.43	2.96
Disgust	-2.01	3.13	-1.94	3.40	-1.23	2.75	-1.56	2.02
Cz								
Neutral	-0.09	1.26	-0.25	2.03	0.28	1.14	0.44	2.11
Violent	0.98	3.47	-0.17	1.97	0.70	1.51	-0.39	2.71
Erotic	0.37	2.97	0.77	1.53	1.53	1.40	-0.17	2.55
Disgust	1.13	2.53	0.16	1.94	0.98	1.50	0.49	1.59
Pz								
Neutral	1.51	1.38	1.50	2.53	1.16	1.81	1.19	2.97
Violent	2.91	3.65	2.40	1.82	1.88	1.98	0.99	2.84
Erotic	1.23	3.17	3.89	1.70	3.29	2.08	1.05	1.61
Disgust	3.69	2.27	2.71	3.20	2.50	2.39	2.09	2.80

Significant differences were found at the Cz (Neutral: $F(3,77) = 4.43$ $p=0.01$, $\eta p2=.14$; Erotic: $F(3,77) = 3.77$ $p=0.01$, $\eta p2=.12$) and Pz (Violent $F(3,77) = 4.02$ $p=0.01$, $\eta p2=.10$) measurement sites across the 100ms epoch. Post hoc tests (Bonferroni correction) revealed that all 4 significant differences were found between HAM/LAF, HAM/HAF or LAF/LAM groups (see Appendix P for p values). It could therefore be argued that these data demonstrate evidence for sex differences in processing rather than an effect moderated by trait aggression score.

These results were similar to the overall median results for the 200ms epoch. Significant differences were found at the Cz (Neutral: $F(3,77) = 4.36$ $p=0.01$, $\eta p2=.15$; Violent: $F(3,77) = 3.05$ $p=0.03$, $\eta p2=.10$) and Pz (Neutral: $F(3,77) = 4.17$ $p=0.01$, $\eta p2=.15$; Violent: $F(3,77) = 9.67$ $p<0.01$, $\eta p2=.19$; Erotic: $F(3,77) = 3.3$ $p=0.02$, $\eta p2=.14$; Disgust: $F(3,77) = 2.87$ $p=0.04$, $\eta p2=.11$) measurement sites across the 200ms epoch. Post hoc tests (Bonferroni correction) revealed a similar pattern to the 100ms epoch where all 8 significant differences were found between different sex groups i.e. LAM/LAF, HAM/LAF, HAM/HAF (see Appendix P for p values). There was no consistency for between sex (i.e. differences between groups HAM/LAM or HAF/LAF) groups. It could therefore be argued that these results demonstrate evidence for sex differences in processing rather than an effect moderated by trait aggression scores.

These results were similar to the overall median results for the 300ms epoch. Significant differences were found at the Pz (Violent: $F(3,77) = 6.50$ $p<0.01$, $\eta p2=.16$; Erotic: $F(3,77) = 3.28$ $p=0.03$, $\eta p2=.13$) measurement site for the 300ms epoch. Post hoc tests (Bonferroni correction) revealed a similar pattern to both previous epochs, all significant differences were found between different sex groups i.e. LAM/HAF, LAM/LAF (see Appendix P for p values). There was no consistency for between sex (i.e. differences between groups HAM/LAM or HAF/LAF) groups. It could therefore be argued that these results demonstrate evidence for sex differences in processing rather than an effect moderated by trait aggression scores.

The results for the overall median analysis differed to those for this analysis. Over this ELPP epoch there were differences found only over the Pz (Violent: $F(3,77) = 4.02$ $p=0.01$, $\eta p2=.12$; Erotic: $F(3,77) = 7.63$ $p<0.01$, $\eta p2=.20$) measurement region. Post hoc tests (Bonferroni correction) revealed that across the 4 significant differences, two were between HAM/LAF or HAF/HAM groups (see Appendix P for p values) and could demonstrate evidence for sex differences in processing. However, there were two differences found between HAM/LAM towards violent ($p<0.01$, $d=1.20$) and erotic ($p<0.01$, $d=1.85$) content. This could demonstrate that over the LLPP epoch there was within-sex (for males only) evidence of differences in response that was moderated by total trait aggression scores. For both categories, HAM responded with a significantly increased positive ERP amplitude in comparison to those in the LAM group (see Table 69.). This showed that those in high aggression groups responded with a significantly increased positive activation in comparison to those in the low aggression groups.

These results showed similarity to the results for the overall median analysis for the LLPP epoch. There was one significant result found at the Pz site in response to erotic ($F(3,77) = 7.47$ $p<0.01$, $\eta p2=.20$) images. Post hoc tests (Bonferroni correction) revealed that across the 2 significant differences, one was LAM/HAF groups (see Appendix P for p values) and could demonstrate evidence for sex differences in processing. However, there was one difference found between HAF/LAF groups towards erotic ($p=0.03$, $d=.68$) content. This could demonstrate that over the LLPP epoch there was within-sex (for females only) evidence of differences in response that was moderated by total trait aggression scores. For the erotic content, the LAF group demonstrated significantly increased positive activation in comparison to the high trait scoring group (see Table 75.). This showed that those in low aggression group responded with a significantly increased positive activation in comparison to those in the high aggression group in response to erotic content. A visual representation of these differences has been provided using ERP waveforms below (see Figure 158 - 173).

Neutral
Violent
Erotic
Disgust

Males

High Aggression

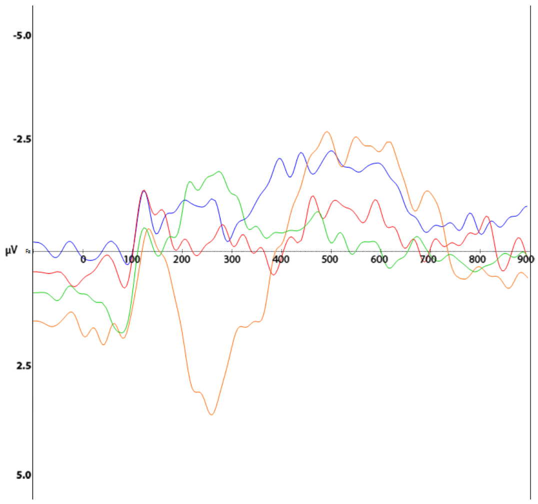


Figure 158. Grand average ERP waveform (microvolts) for HAM at the Fz location, across time (milliseconds).

Low Aggression

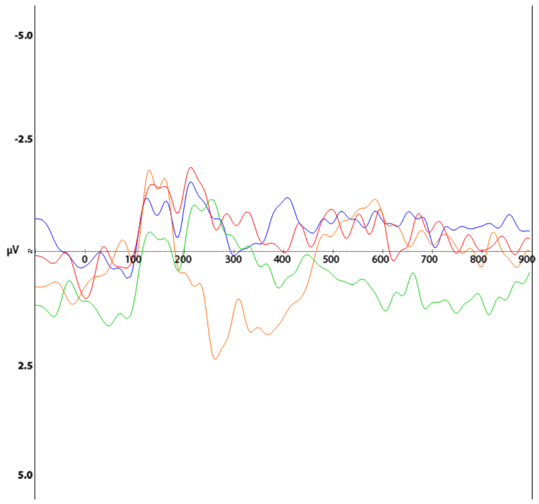


Figure 159. Grand average ERP waveform (microvolts) for LAM at the Fz location, across time (milliseconds).

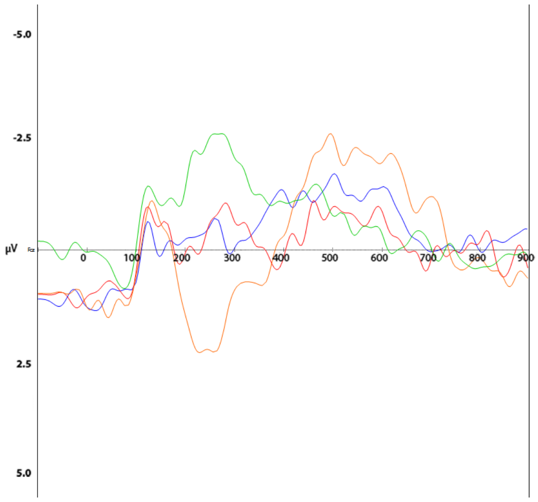


Figure 160. Grand average ERP waveform (microvolts) for HAM at the Fcz location, across time (milliseconds).

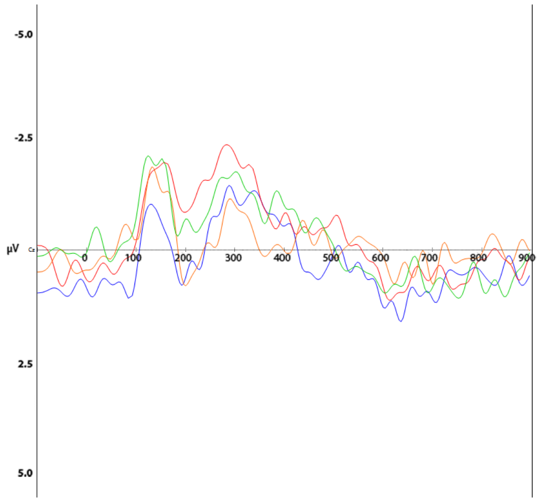


Figure 161. Grand average ERP waveform (microvolts) for LAM at the Fcz location, across time (milliseconds).

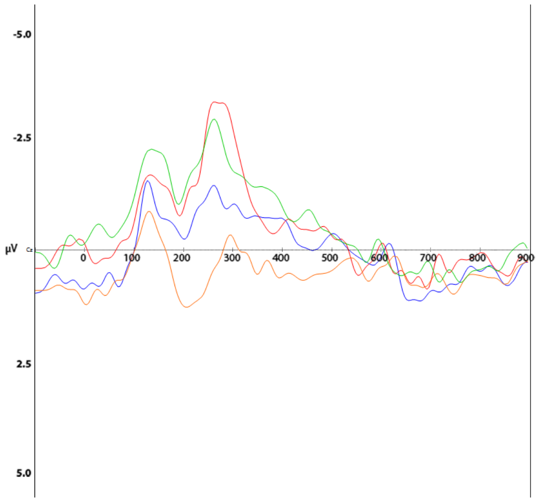


Figure 162. Grand average ERP waveform (microvolts) for HAM at the Cz location, across time (milliseconds).

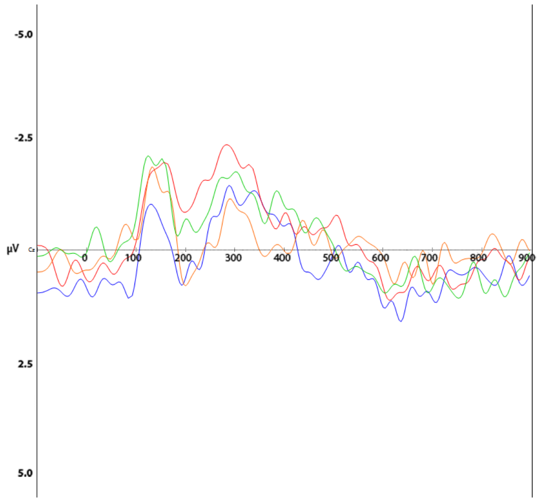
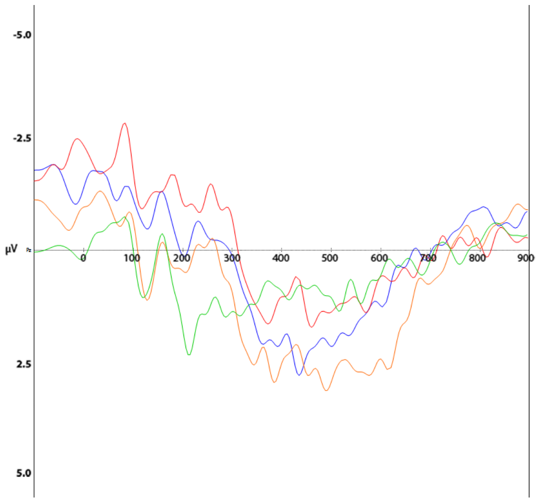


Figure 163. Grand average ERP waveform (microvolts) for LAM at the Cz location, across time (milliseconds).



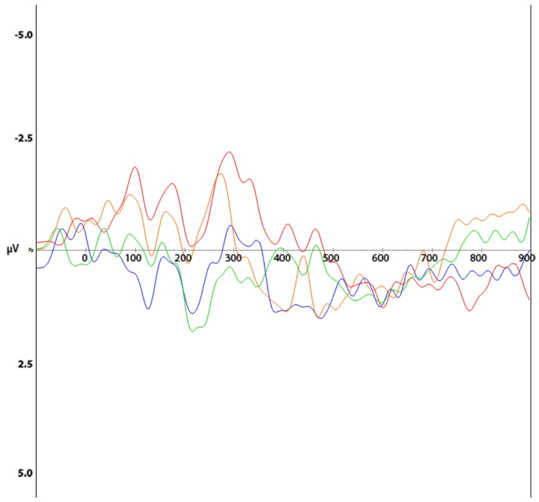


Figure 164. Grand average ERP waveform (microvolts) for HAM at the Pz location, across time (milliseconds).

Figure 165. Grand average ERP waveform (microvolts) for LAM at the Pz location, across time (milliseconds).

Females

High Aggression

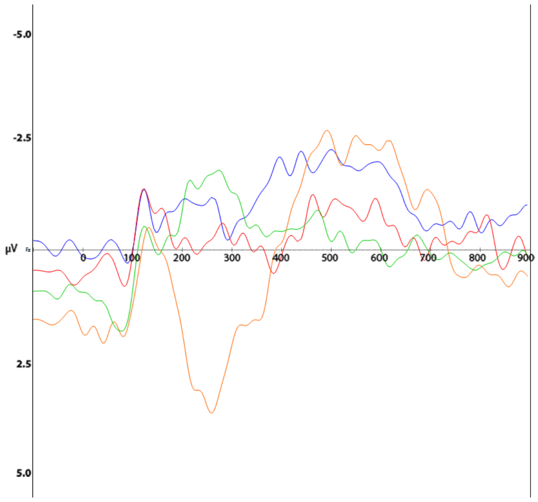


Figure 166. Grand average ERP waveform (microvolts) for HAF at the Fz location, across time (milliseconds).

Low Aggression

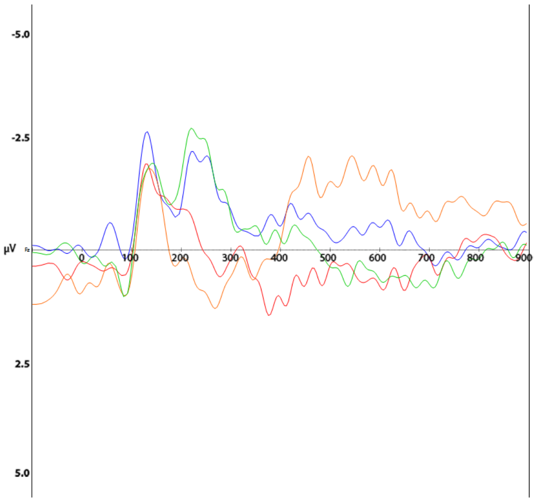


Figure 167. Grand average ERP waveform (microvolts) for LAF at the Fz location, across time (milliseconds).

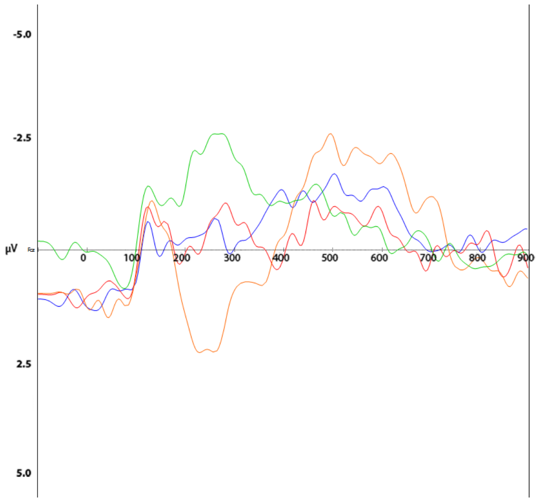


Figure 168. Grand average ERP waveform (microvolts) for HAF at the Fcz location, across time (milliseconds).

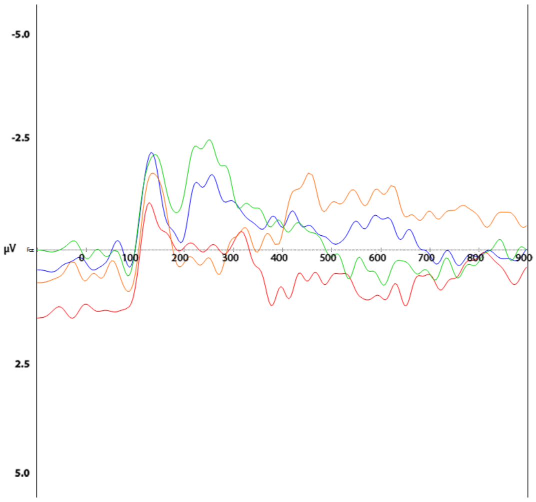


Figure 169. Grand average ERP waveform (microvolts) for LAF at the Fcz location, across time (milliseconds).

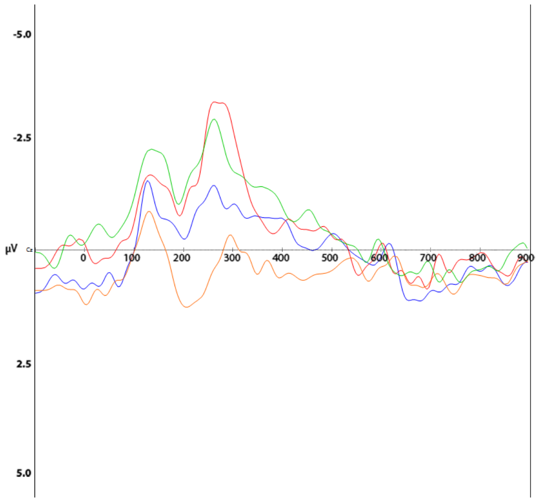


Figure 170. Grand average ERP waveform (microvolts) for HAF at the Cz location, across time (milliseconds).

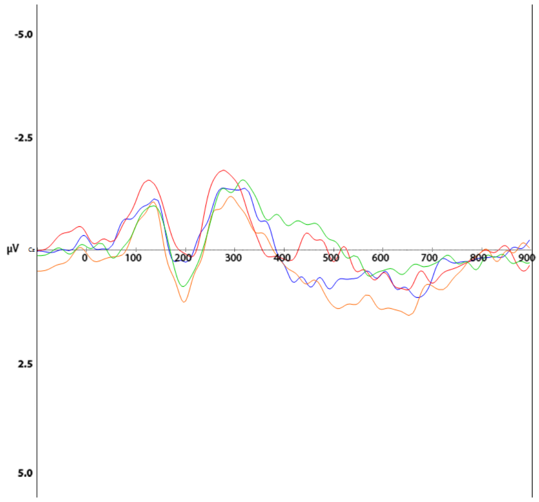


Figure 171. Grand average ERP waveform (microvolts) for LAF at the Cz location, across time (milliseconds).

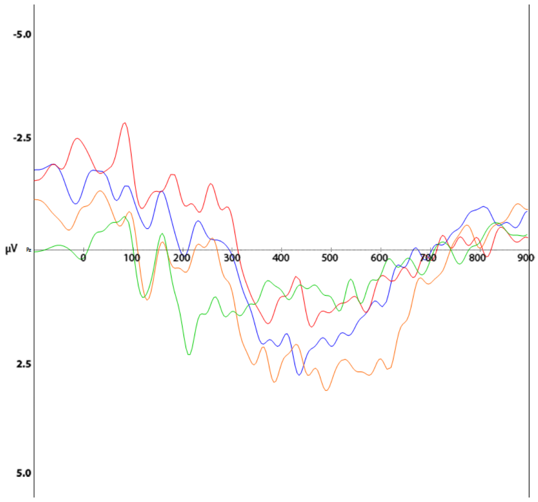


Figure 172. Grand average ERP waveform (microvolts) for HAF at the Pz location, across time (milliseconds).

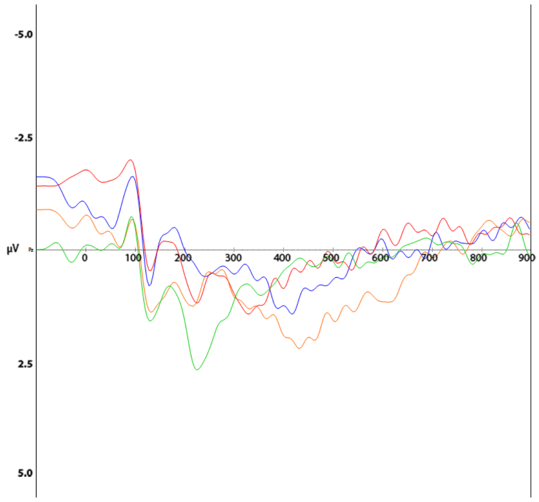


Figure 173. Grand average ERP waveform (microvolts) for LAF at the Pz location, across time (milliseconds).

5.5.3 Method 4: Trait Aggression (25th and 75th Percentile) Overall and Within-sex Data.

This analysis used the 25th and 75th data percentile to define high (participants scoring above the 75th percentile) or low total scores (participants scoring below the 25th percentile) on the Buss and Perry (1992) Aggression Questionnaire. Overall, the 25th percentile value was 57.25 (males= 66; females= 53) and the 75th percentile value was 81.25

(males=82; females=75). Therefore, both the analysis for overall and within-sex have been provided below separately.

5.5.3.1 Overall Results

The following data tables (Tables 89 - 93) were collated using the overall 25th and 75th percentile values to define the divides for high or low scores on the Buss and Perry (1992) Aggression Questionnaire by location and epoch to affective images. Total aggression score means and standard deviations were similar across high (HAF mean=88.67, SD=7.62; HAM mean=89.5, SD=7.26) and low groups (LAF mean= 44.17, SD=6.92; LAM mean=48.14, SD=4.26) however, standard deviations were marginally larger for the high scoring groups in comparison to the low scoring groups demonstrating a larger variance around the mean.

5.5.3.2 50 – 150ms Post Stimuli (100ms) Overall Averages

Table 89. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 100ms timeframe.

100ms	High Aggression Females (n=9)		High Aggression Males (n=10)		Low Aggression Females (n=12)		Low Aggression Males (n=7)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.26	1.68	0.56	2.75	-1.22	2.34	-0.89	0.97
Violent	-2.02	1.62	-1.49	0.64	-1.03	2.13	-1.67	0.75
Erotic	-0.48	1.48	-1.57	2.03	-0.47	2.65	-2.16	2.04
Disgust	-1.02	1.25	-0.07	0.82	-1.74	1.79	-0.62	1.94
Fcz								
Neutral	-1.67	1.46	-0.19	1.68	-1.36	2.00	-1.42	1.09
Violent	-2.41	1.63	-1.58	0.86	-1.07	1.70	-2.04	0.77
Erotic	-1.18	1.00	-1.43	1.68	-0.54	2.04	-2.18	1.75
Disgust	-1.69	0.94	-0.51	0.87	-1.64	1.67	-1.15	1.67
Cz								

Neutral	-0.64	0.92	-1.41	1.86	-0.68	1.26	-1.96	0.68
Violent	-0.83	1.91	-1.29	1.84	-0.82	0.79	-2.13	0.73
Erotic	-0.94	0.57	-1.08	1.44	-0.51	0.97	-1.45	1.00
Disgust	-0.85	0.78	-0.68	1.24	-0.86	0.76	-2.09	1.25
Pz								
Neutral	0.99	1.54	-0.15	2.80	0.81	2.36	-0.76	1.57
Violent	1.10	1.44	-0.06	2.30	0.59	1.56	-0.40	1.39
Erotic	-0.15	1.86	0.79	1.20	0.75	1.91	-0.20	1.25
Disgust	0.48	1.49	0.23	2.04	0.19	2.42	-0.90	1.54

5.5.3.3 150 – 250ms Post Stimuli (200ms) Overall Averages

Table 90. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 200ms timeframe.

200ms	High Aggression Females (n=9)		High Aggression Males (n=10)		Low Aggression Females (n=12)		Low Aggression Males (n=7)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-3.44	2.34	0.20	2.46	-3.47	3.89	-2.34	2.05
Violent	-2.47	2.09	0.79	2.10	-1.48	4.07	-3.22	2.29
Erotic	1.35	2.87	2.66	3.72	0.35	4.57	-0.78	1.30
Disgust	-1.96	1.69	0.87	2.98	-2.65	3.53	-2.27	1.74
Fcz								
Neutral	-3.42	1.62	-0.54	1.72	-3.07	3.49	-2.74	1.81
Violent	-3.22	1.32	0.22	1.89	-1.75	3.18	-3.89	2.42
Erotic	0.27	2.05	2.31	3.31	-0.23	3.53	-1.34	0.62
Disgust	-2.38	1.31	0.31	3.05	-2.40	3.29	-2.50	1.67
Cz								
Neutral	0.03	2.64	-1.06	2.04	0.02	1.80	-1.39	2.15

Violent	0.03	3.65	-0.95	2.96	-0.38	1.61	-3.22	2.43
Erotic	0.08	1.12	1.66	2.72	-0.09	1.55	-0.88	0.97
Disgust	0.25	1.90	-0.11	2.92	-0.70	1.17	-1.48	2.57
Pz								
Neutral	3.63	2.86	1.28	2.17	3.51	3.50	1.36	2.38
Violent	3.37	3.82	-0.02	2.62	2.61	2.88	0.46	0.87
Erotic	0.83	2.97	1.57	1.63	1.83	2.55	0.74	1.29
Disgust	2.91	2.88	0.05	4.22	1.48	4.15	1.82	1.68

5.5.3.4 250 – 450ms Post Stimuli (300ms) Overall Averages

Table 91. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 300ms timeframe.

300ms	High Aggression Females (n=9)		High Aggression Males (n=10)		Low Aggression Females (n=12)		Low Aggression Males (n=7)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-2.07	3.31	-1.01	2.92	-2.35	3.58	-1.29	1.86
Violent	-1.60	4.17	0.85	5.07	-0.80	4.71	-2.13	3.42
Erotic	-0.06	5.12	1.16	4.79	-1.01	4.82	1.39	1.46
Disgust	-3.28	2.80	-0.58	2.91	-2.28	4.66	-1.41	1.51
Fcz								
Neutral	-3.00	2.31	-1.76	2.38	-2.88	3.15	-2.45	1.86
Violent	-3.14	2.61	-0.05	4.32	-1.73	3.90	-3.70	3.75
Erotic	-1.30	3.77	0.72	3.53	-1.67	3.73	-0.11	1.22
Disgust	-4.00	2.16	-0.82	2.94	-2.53	4.08	-2.61	2.11
Cz								
Neutral	-1.18	2.07	-0.84	2.68	-1.48	2.07	-2.75	2.12
Violent	0.24	4.36	-0.60	3.22	-0.46	1.89	-4.76	3.01

Erotic	-0.68	2.03	1.02	1.79	-0.26	1.87	-1.68	0.97
Disgust	-0.61	2.94	-0.46	3.61	-0.84	1.85	-3.47	2.23
Pz								
Neutral	2.21	2.07	2.96	2.40	2.30	2.74	-0.35	2.10
Violent	4.51	4.27	2.31	2.23	3.66	2.75	-0.39	1.91
Erotic	2.13	2.31	4.54	2.95	3.34	3.12	0.91	2.80
Disgust	3.55	2.65	3.11	4.18	3.01	4.39	1.08	1.82

5.5.3.5 450 – 650ms Post Stimuli (ELPP) Overall Averages

Table 92. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the ELPP timeframe.

ELPP	High Aggression Females (n=9)		High Aggression Males (n=10)		Low Aggression Females (n=12)		Low Aggression Males (n=7)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.80	3.51	-0.48	3.56	-0.83	3.19	0.23	1.54
Violent	-1.25	4.16	-0.59	4.88	-0.41	3.39	-1.76	2.59
Erotic	-3.31	5.47	-2.86	5.89	-3.30	6.83	-0.79	2.51
Disgust	-3.83	3.07	-1.50	2.51	-2.88	4.59	-1.27	1.63
Fcz								
Neutral	-2.48	2.51	-1.20	2.82	-1.34	2.72	-0.72	1.17
Violent	-2.37	2.49	-1.07	4.38	-0.93	2.98	-2.95	2.95
Erotic	-3.68	4.08	-2.46	5.68	-2.60	5.45	-1.54	2.25
Disgust	-3.91	2.40	-1.10	2.62	-2.58	4.36	-1.85	1.86
Cz								
Neutral	-0.75	1.96	0.22	2.35	-0.18	1.60	-0.89	0.71
Violent	1.58	5.45	-0.16	2.65	0.56	1.59	-3.15	1.74
Erotic	-0.72	2.76	0.76	2.57	1.74	1.84	-1.06	1.45

Disgust	0.01	2.89	-0.15	3.09	0.58	2.19	-1.10	1.45
Pz								
Neutral	2.06	1.95	3.40	2.64	1.92	2.22	0.18	1.22
Violent	5.10	5.22	3.09	1.78	3.10	1.76	0.57	2.09
Erotic	2.45	2.11	6.33	2.55	4.41	2.81	1.53	2.61
Disgust	3.92	1.17	3.47	3.13	3.21	3.60	2.41	3.32

5.5.3.6 650 – 850ms Post Stimuli (LLPP) Overall Averages

Table 93. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the LLPP timeframe.

LLPP	High Aggression Females (n=9)		High Aggression Males (n=10)		Low Aggression Females (n=12)		Low Aggression Males (n=7)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.68	2.33	-0.08	3.88	-0.24	2.71	0.98	0.83
Violent	-0.69	2.94	-0.98	4.48	-0.53	2.71	-0.83	1.93
Erotic	-3.74	5.32	-1.10	3.26	-2.84	5.15	0.38	1.40
Disgust	-4.24	3.48	-1.23	1.91	-1.12	2.70	-1.50	1.31
Fcz								
Neutral	-1.86	1.70	-0.49	2.99	-0.57	2.34	0.16	0.55
Violent	-1.41	1.78	-1.00	3.91	-0.82	2.30	-1.28	2.18
Erotic	-3.80	4.27	-0.78	2.97	-2.25	3.90	-0.32	1.16
Disgust	-3.83	2.50	-0.86	2.42	-1.25	2.39	-1.70	1.46
Cz								
Neutral	-0.27	1.56	0.79	1.51	0.42	1.38	-0.10	0.31
Violent	2.45	4.92	0.27	2.56	0.55	1.10	-1.04	1.34
Erotic	-1.06	3.20	1.23	1.44	1.44	1.40	-0.21	0.89
Disgust	0.39	3.01	0.40	2.35	0.57	1.45	-0.44	0.61

Pz								
Neutral	1.69	1.28	2.70	3.05	1.53	1.74	-0.12	0.87
Violent	4.73	4.77	2.35	1.48	2.34	1.73	0.81	1.99
Erotic	0.85	2.59	4.76	1.55	2.92	2.15	0.85	1.55
Disgust	3.17	1.77	2.29	2.57	2.22	2.72	1.96	2.14

Over the 100ms epoch there was one significant result found at the Cz site in response to disgust ($F(3,37) = 3.22$ $p=0.03$, $\eta p2=.18$) images (see Appendix Q for comprehensive results). Post hoc (Bonferroni correction) test revealed that the difference was between HAM/LAM ($p=0.04$) groups (see Appendix R for all values). The LAM group demonstrated significantly increased negative activation in comparison to the high trait scoring group (see Table 76.). This could demonstrate that over the 100ms epoch there was within-sex (for males only) evidence of differences in response towards disgust content, at the Cz site, that was moderated by total trait aggression scores.

Over the 200ms epoch there were differences found at the Fz (Neutral: $F(3,37) = 3.55$ $p=0.02$, $\eta p2=.21$; Violent: $F(3,37) = 3.2$ $p=0.04$, $\eta p2=.22$; Disgust: $F(3,37) = 3.44$ $p=0.03$, $\eta p2=.19$), Fcz (Violent: $F(3,37) = 5.2$ $p<0.01$, $\eta p2=.24$), Cz (Erotic: $F(3,37) = 3.17$ $p=0.04$, $\eta p2=.14$) and Pz (Violent: $F(3,37) = 3.12$ $p=0.04$, $\eta p2=.21$) measurement sites. Post hoc tests (Bonferroni correction) revealed that across the 5 significant differences, the majority (n=3) were between HAM/LAF or HAF/HAM groups (see Appendix R for all p values) and could demonstrate evidence for sex differences in processing. However, over the Fcz and Cz sites, there were significant differences found between HAM/LAM. In the Fcz there were significant differences found towards violent ($p=0.01$, $d=1.42$) and in the Cz region there were significant differences found in response to erotic ($p=0.04$, $d=1.29$) content. This could demonstrate that over the 200ms epoch there was within-sex evidence (for males only) of differences in response that was moderated by total trait aggression scores. For the violent content in the Fcz region, the LAM group responded with significant increased negative activation in comparison to the HAM group. In response to the erotic content over the central cluster, HAM group responded with a significantly increased positive ERP amplitude in comparison to those in the LAM group who responded with negative activation (see Table 77.). This demonstrated that trait aggression potentially moderated response towards both erotic and violent content in the 200ms epoch.

Significant differences were found at the Cz (Violent: $F(3,37) = 3.92$ $p=0.02$, $\eta p2=.20$; Erotic: $F(3,37) = 3.42$ $p=0.03$, $\eta p2=.18$) and Pz (Violent: $F(3,37) = 4.17$ $p=0.01$, $\eta p2=.25$) measurement sites for the

300ms epoch. Post hoc tests (Bonferroni correction) revealed that across the 5 significant differences, the majority (n=4) were between LAM/LAF or LAM/HAF groups (see Appendix R for all p values) and could demonstrate evidence for sex differences in processing. However, over the Cz site, there were one significant difference found between HAM/LAM towards erotic content (p=0.02). This could demonstrate that over the LLPP epoch there was within-sex evidence (for males only) of differences in central regions towards erotic content that was moderated by total trait aggression scores. It was shown that the LAM group responded with slightly increased response in a negative direction in comparison to the positive amplitude response from the HAM group (see Table 78.). This demonstrated that trait aggression potentially moderated response towards erotic content in the 300ms epoch.

Over the ELPP epoch there were differences found at the Cz (Violent: $F(3,37) = 3.13$ $p=0.04$, $\eta p2=.16$; Erotic: $F(3,37) = 3.27$ $p=0.03$, $\eta p2=.15$) and Pz (Neutral: $F(3,37) = 3.12$ $p=0.04$, $\eta p2=.12$; Violent: $F(3,37) = 2.98$ $p=0.05$, $\eta p2=.18$; Erotic: $F(3,37) = 6.18$ $p<0.01$, $\eta p2=.27$) measurement sites. Post hoc tests (Bonferroni correction) demonstrated that across the 8 significant differences, the majority (n=5) were between HAF/LAM, LAF/LAM or HAF/HAM groups (see Appendix R for p values) and could demonstrate evidence for sex differences in processing. However, over the central region there was one significant difference found between HAM/ LAM groups towards erotic (p=0.02, d=.98) content and in the parietal region there were significant differences found between HAM/LAM towards neutral (p=0.01, d=1.57) and erotic (p<0.01, d=1.28) content. This could demonstrate that over the ELPP epoch there was within-sex evidence (for males only) of differences in response towards neutral and erotic content that was moderated by total trait aggression score. Across the central site, the LAM group showed significantly increase activation that was negative in amplitude in comparison to the positive activation demonstrated by those in the HAM group in response to erotic content. However, in the parietal region, those in the HAM group responded with a significantly increased positive ERP amplitude in comparison to those in the LAM group towards both neutral and erotic content. This demonstrated that there were differences moderated by trait aggression score in response to erotic and neutral content (for males only) across the ELPP epoch.

Over the LLPP epoch there were differences found at the Fz (Disgust: $F(3,37) = 3.2$ $p=0.04$, $\eta p2=.16$), Fcz (Disgust: $F(3,37) = 3.2$ $p=0.04$, $\eta p2=.14$), Cz (Erotic: $F(3,37) = 3.7$ $p=0.02$, $\eta p2=.14$) and Pz (Erotic $F(3,37) = 7.82$ $p<0.01$, $\eta p2=.27$) measurement sites. Post hoc tests (Bonferroni correction) demonstrated that across the 4 significant differences 2 were between HAF/HAM groups (see Appendix R for p values) and could demonstrate evidence for sex differences in processing. However, over the central region there was one significant difference found between HAF/ LAF groups towards erotic (p=0.04, d=1.01) content and also in the parietal region there was a significant difference found between HAM/LAM groups towards erotic (p<0.01, d=2.52) content. This could demonstrate that over the LLPP epoch there was within-sex evidence of differences in response towards erotic content that was moderated by total trait aggression score. At the central site, the LAF group showed significantly increased activation that was positive in amplitude in comparison to the negative activation demonstrated by those in the HAF group. However, in the parietal region, those in the HAM group responded with a significantly increased positive ERP amplitude in comparison to those in the LAM group. This demonstrated that there were differences moderated by trait aggression score in response to erotic content across the ELPP epoch. A visual representation has been provided using ERP waveforms below (see Figure 174 - 189).

Neutral
Violent
Erotic
Disgust

Males

High Aggression

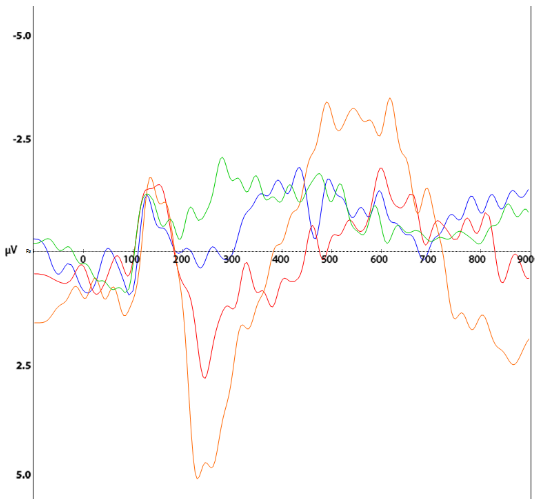


Figure 174. Grand average ERP waveform (microvolts) for HAM at the Fz location, across time (milliseconds).

Low Aggression

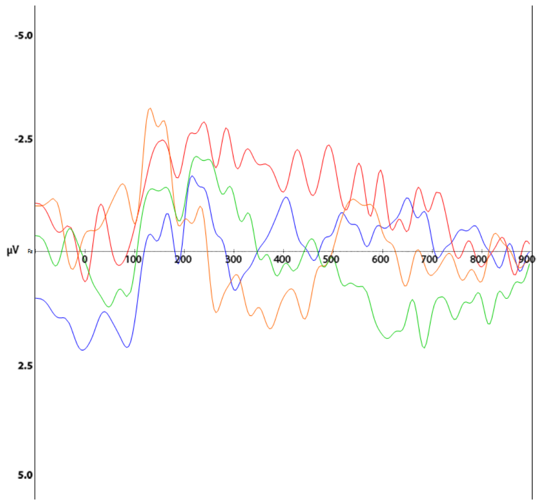


Figure 175. Grand average ERP waveform (microvolts) for LAM at the Fz location, across time (milliseconds).

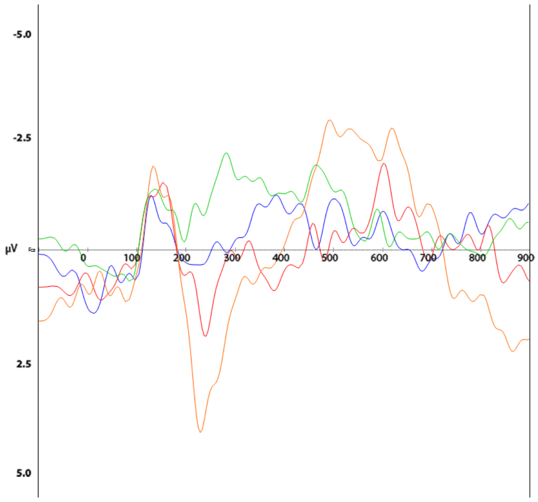


Figure 176. Grand average ERP waveform (microvolts) for HAM at the Fcz location, across time (milliseconds).

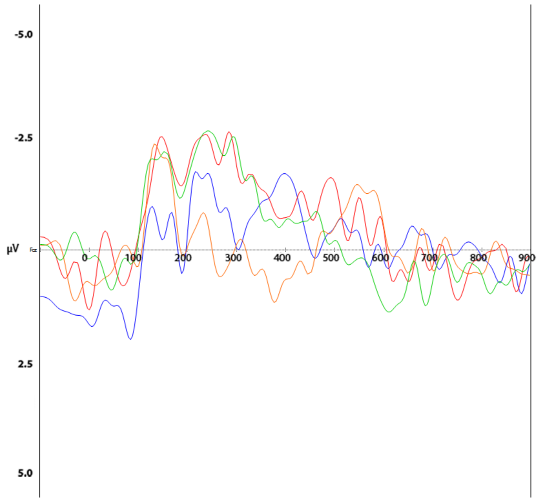


Figure 177. Grand average ERP waveform (microvolts) for LAM at the Fcz location, across time (milliseconds).

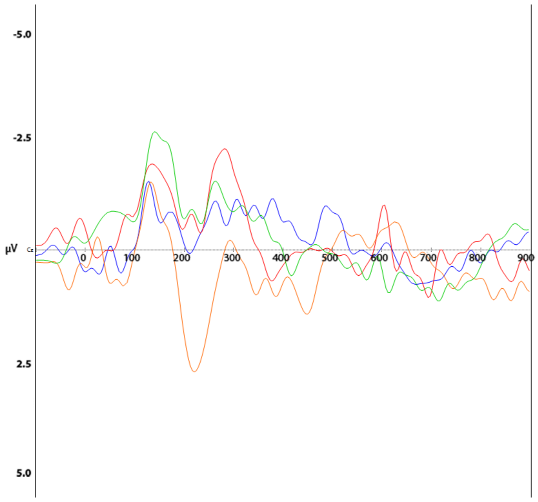


Figure 178. Grand average ERP waveform (microvolts) for HAM at the Cz location, across time (milliseconds).

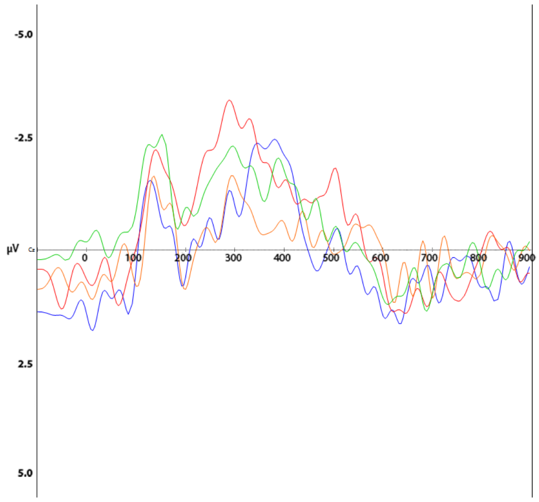
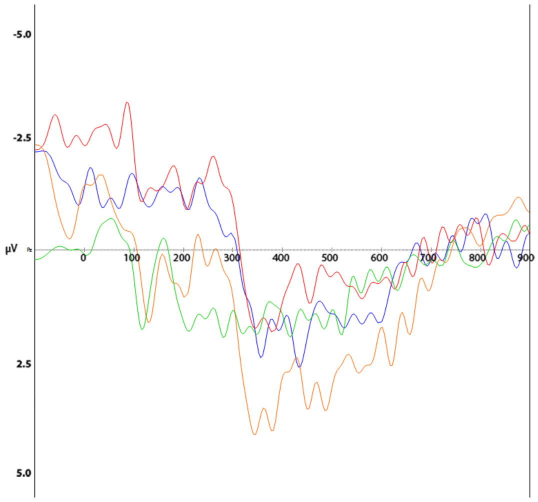


Figure 179. Grand average ERP waveform (microvolts) for LAM at the Cz location, across time (milliseconds).



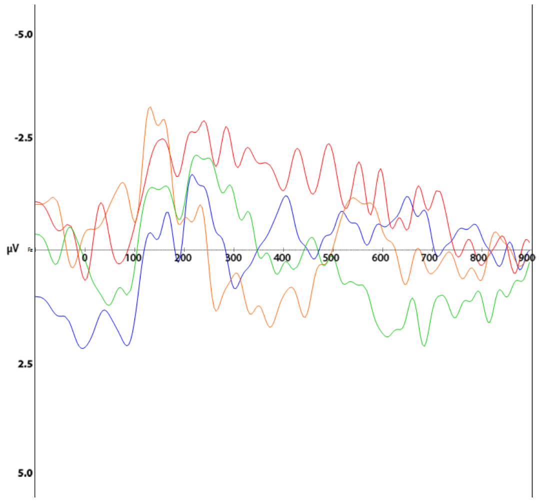


Figure 180. Grand average ERP waveform (microvolts) for HAM at the Pz location, across time (milliseconds).

Figure 181. Grand average ERP waveform (microvolts) for LAM at the Pz location, across time (milliseconds).

Females

High Aggression

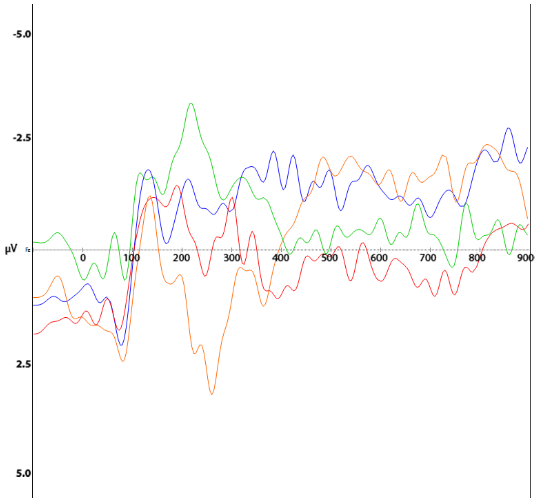


Figure 182. Grand average ERP waveform (microvolts) for HAF at the Fz location, across time (milliseconds).

Low Aggression

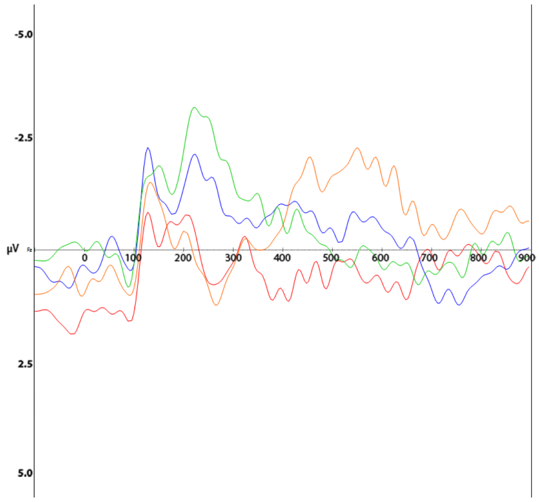


Figure 183. Grand average ERP waveform (microvolts) for LAF at the Fz location, across time (milliseconds).

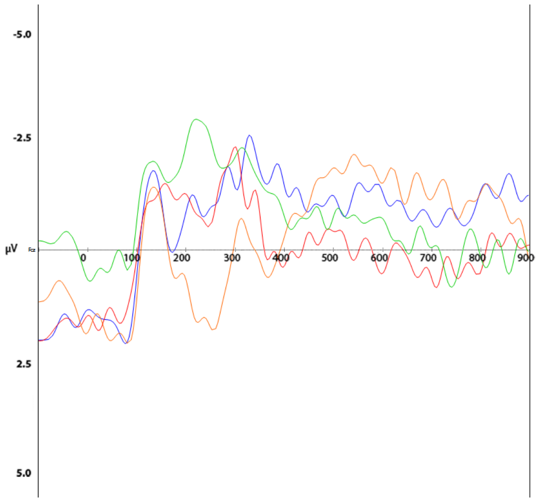


Figure 184. Grand average ERP waveform (microvolts) for HAF at the Fcz location, across time (milliseconds).

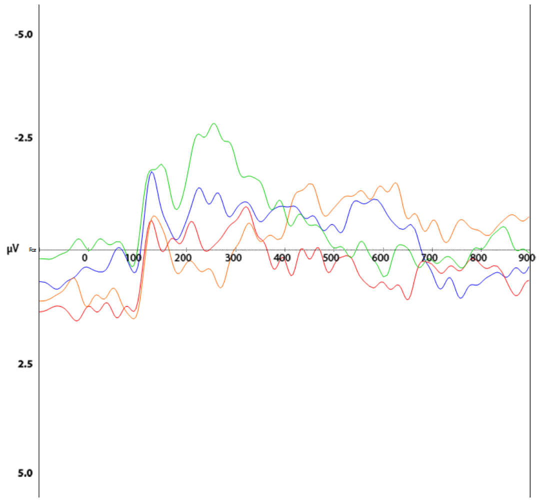


Figure 185. Grand average ERP waveform (microvolts) for LAF at the Fcz location, across time (milliseconds).

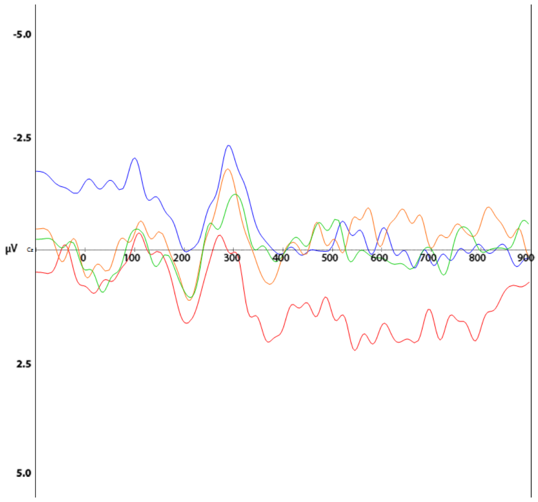


Figure 186. Grand average ERP waveform (microvolts) for HAF at the Cz location, across time (milliseconds).

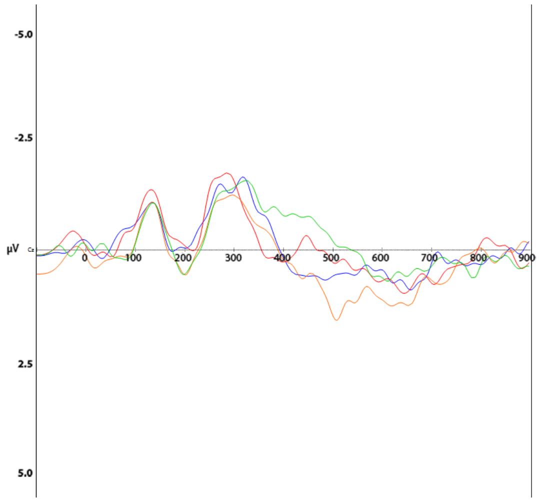


Figure 187. Grand average ERP waveform (microvolts) for LAF at the Cz location, across time (milliseconds).

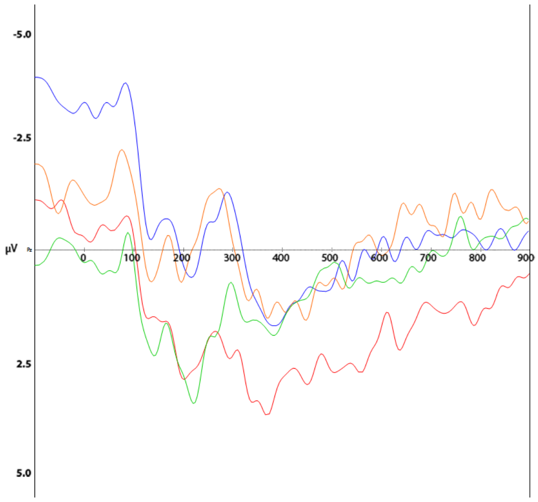


Figure 188. Grand average ERP waveform (microvolts) for HAF at the Pz location, across time (milliseconds).

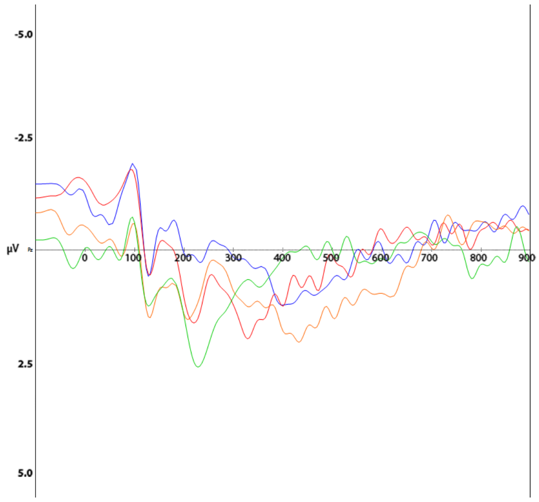


Figure 189. Grand average ERP waveform (microvolts) for LAF at the Pz location, across time (milliseconds).

5.5.3.7 Method 5: Within-Sex Results (Weighted)

The following data tables (Tables 94-98) were collated using the within-sex 25th and 75th percentiles to define group criteria for high or low scores on the Buss and Perry (1992) Aggression Questionnaire by location and epoch to affective images. The 25th percentile (males= 66; females= 53) and the 75th percentile (males=82; females=75). Descriptive statistics have been provided in the below succession of tables for mean ERP amplitude in response to image (see Tables 94-98). Total aggression score means and standard deviations were similar across high (HAF mean=87.4, SD=8.22; HAM mean=91.38, SD=6.91) and low groups (LAF mean= 42.2, SD=5.71; LAM mean=49.62, SD=5.76) however, standard deviations were marginally larger for the high scoring groups in comparison to the low scoring groups demonstrating a larger variance around the mean. As expected, there were significant differences found between high and low scoring groups in response to images, across epoch and location.

5.5.3.8 50 – 150ms Post Stimuli (100ms) Within-Sex

Table 94. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 100ms timeframe.

100ms	High Aggression Females (n=10)		High Aggression Males (n=8)		Low Aggression Females (n=10)		Low Aggression Males (n=8)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.46	1.71	0.58	3.12	-1.56	2.41	-0.69	1.06
Violent	-2.04	1.53	-1.40	0.69	-1.33	2.18	-1.30	1.25
Erotic	-0.62	1.46	-2.22	1.72	-0.73	2.80	-2.33	1.94
Disgust	-1.18	1.28	0.00	0.91	-2.06	1.64	-0.69	1.80
Fcz								
Neutral	-1.81	1.44	-0.27	1.90	-1.62	2.08	-1.38	1.01
Violent	-2.38	1.54	-1.50	0.96	-1.30	1.68	-1.82	0.95
Erotic	-1.22	0.96	-1.90	1.53	-0.67	2.18	-2.58	1.98
Disgust	-1.69	0.89	-0.60	0.96	-1.92	1.52	-1.56	1.94
Cz								
Neutral	-0.73	0.91	-1.79	1.91	-0.36	1.05	-2.14	0.81
Violent	-0.98	1.87	-1.27	2.08	-0.77	0.82	-2.35	0.90
Erotic	-0.96	0.54	-1.37	1.48	-0.49	1.05	-1.61	1.02
Disgust	-0.90	0.75	-1.07	1.05	-0.71	0.74	-1.97	1.21
Pz								
Neutral	1.15	1.53	-0.41	3.12	1.19	2.42	-1.30	2.10

Violent	1.01	1.38	0.08	2.58	0.81	1.59	-1.46	3.25
Erotic	0.00	1.82	0.60	1.28	0.81	2.09	-0.58	1.59
Disgust	0.55	1.43	-0.48	1.57	0.63	2.28	-0.28	2.26

5.5.3.9 150 – 250ms Post Stimuli (200ms) Within-Sex

Table 95. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 200ms timeframe.

200ms	High Aggression Females (n=10)		High Aggression Males (n=8)		Low Aggression Females (n=10)		Low Aggression Males (n=8)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-3.57	2.25	0.18	2.79	-4.19	3.83	-2.00	2.12
Violent	-2.75	2.16	1.47	1.74	-2.21	3.91	-2.51	2.91
Erotic	1.15	2.78	2.49	4.20	-0.31	4.51	-0.78	1.20
Disgust	-2.26	1.86	0.92	3.38	-3.45	3.04	-2.11	1.68
Fcz								
Neutral	-3.52	1.56	-0.68	1.92	-3.68	3.48	-2.52	1.78
Violent	-3.39	1.35	0.74	1.73	-2.39	2.97	-3.16	3.04
Erotic	0.16	1.96	2.22	3.75	-0.70	3.56	-1.72	1.21
Disgust	-2.49	1.28	0.11	3.43	-3.14	2.87	-2.58	1.56
Cz								
Neutral	-0.09	2.51	-1.49	2.07	0.29	1.75	-1.12	2.13
Violent	-0.07	3.46	-1.07	3.34	-0.63	1.62	-3.41	2.31
Erotic	0.00	1.08	1.50	3.06	-0.30	1.61	-0.71	1.02
Disgust	0.11	1.85	-0.78	2.90	-0.60	1.13	-1.56	2.39
Pz								
Neutral	3.80	2.75	0.79	2.17	4.37	3.15	1.05	2.37
Violent	3.49	3.62	-0.37	2.85	2.86	3.11	-0.90	3.94

Erotic	1.05	2.89	1.14	1.52	2.02	2.78	0.15	2.07
Disgust	2.99	2.73	-1.09	3.93	2.55	2.96	1.39	1.97

5.5.3.10 250 – 450ms Post Stimuli (300ms) Within-Sex

Table 96. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 300ms timeframe.

300ms	High Aggression Females (n=10)		High Aggression Males (n=8)		Low Aggression Females (n=10)		Low Aggression Males (n=8)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-2.20	3.15	-0.57	3.14	-2.80	3.77	-1.31	1.73
Violent	-1.42	3.98	1.87	5.21	-1.39	4.77	-1.53	3.59
Erotic	-0.17	4.84	2.16	4.87	-1.00	5.15	1.46	1.37
Disgust	-3.27	2.64	0.01	2.98	-3.03	4.52	-1.18	1.54
Fcz								
Neutral	-2.99	2.18	-1.53	2.64	-3.33	3.27	-2.58	1.76
Violent	-2.91	2.56	0.66	4.60	-2.27	3.91	-2.64	4.59
Erotic	-1.33	3.56	1.41	3.64	-1.65	3.97	-0.35	1.33
Disgust	-3.85	2.09	-0.61	3.30	-3.22	3.88	-2.59	1.96
Cz								
Neutral	-1.18	1.96	-0.84	3.04	-1.33	2.18	-2.34	2.28
Violent	0.11	4.13	-0.72	3.65	-0.42	2.08	-4.48	2.89
Erotic	-0.66	1.91	1.23	1.97	-0.12	2.00	-1.20	1.64
Disgust	-0.67	2.78	-1.09	3.80	-0.55	1.85	-3.08	2.33
Pz								
Neutral	2.27	1.96	2.56	2.55	2.77	2.71	-0.09	2.08
Violent	4.41	4.04	1.75	2.15	4.21	2.66	-1.64	3.94
Erotic	2.25	2.21	4.02	3.11	3.86	3.18	0.94	2.60

Disgust	3.45	2.52	1.76	3.48	4.18	3.01	0.47	2.42

5.5.3.11450 – 650ms Post Stimuli (ELPP) Within-Sex

Table 97. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the ELPP timeframe.

ELPP	High Aggression Females (n=10)		High Aggression Males (n=8)		Low Aggression Females (n=10)		Low Aggression Males (n=8)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-2.07	3.41	-0.50	4.04	-0.88	3.35	-0.14	1.77
Violent	-0.89	4.08	-0.43	5.52	-0.61	3.60	-1.46	2.55
Erotic	-3.79	5.37	-3.60	6.43	-2.84	7.39	-0.65	2.36
Disgust	-3.74	2.91	-1.59	2.84	-2.82	5.07	-0.96	1.75
Fcz								
Neutral	-2.61	2.41	-1.37	3.17	-1.53	2.87	-1.29	1.94
Violent	-2.04	2.58	-1.01	4.96	-1.15	3.13	-2.37	3.19
Erotic	-3.96	3.95	-3.31	6.11	-2.22	5.92	-1.73	2.15
Disgust	-3.75	2.32	-1.40	2.89	-2.71	4.81	-1.82	1.73
Cz								
Neutral	-0.69	1.86	0.28	2.66	-0.31	1.73	-0.26	1.90
Violent	1.34	5.19	-0.33	2.98	0.47	1.60	-2.88	1.80
Erotic	-0.75	2.61	0.40	2.79	1.67	1.76	-0.24	2.67
Disgust	0.01	2.72	-0.85	3.08	0.67	2.41	-0.45	2.27
Pz								
Neutral	2.30	1.99	3.63	2.95	1.96	2.41	1.04	2.70
Violent	4.81	5.01	3.00	2.01	3.37	1.82	0.04	2.45
Erotic	2.61	2.05	6.50	2.86	4.74	2.98	1.63	2.44
Disgust	3.79	1.18	2.73	3.06	4.06	2.72	1.91	3.39

5.5.3.12650 – 850ms Post Stimuli (LLPP) Within-Sex

Table 98. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the LLPP timeframe

LLPP	High Aggression Females (n=10)		High Aggression Males (n=8)		Low Aggression Females (n=10)		Low Aggression Males (n=8)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.77	2.22	0.58	4.11	-0.18	2.45	0.62	1.27
Violent	-0.69	2.78	-0.63	5.01	-0.87	2.86	-1.06	1.91
Erotic	-4.36	5.39	-1.83	3.26	-2.70	5.67	0.91	1.99
Disgust	-3.88	3.47	-1.41	2.12	-1.05	2.95	-1.16	1.55
Fcz								
Neutral	-1.89	1.61	-0.10	3.26	-0.63	2.21	-0.25	1.27
Violent	-1.38	1.68	-0.86	4.42	-1.17	2.37	-1.25	2.02
Erotic	-4.17	4.19	-1.51	2.87	-2.07	4.26	0.09	1.58
Disgust	-3.55	2.52	-1.26	2.57	-1.32	2.59	-1.76	1.36
Cz								
Neutral	-0.31	1.47	1.18	1.43	0.26	1.45	0.21	0.93
Violent	2.20	4.71	0.22	2.90	0.36	1.08	-1.37	1.56
Erotic	-0.99	3.02	0.82	1.31	1.22	1.28	0.68	2.66
Disgust	0.42	2.84	-0.18	2.27	0.80	1.46	-0.16	0.96
Pz								
Neutral	1.77	1.24	2.92	3.42	1.45	1.89	0.79	2.71
Violent	4.53	4.54	2.20	1.64	2.27	1.84	-0.01	2.95
Erotic	1.12	2.59	4.64	1.73	3.00	2.35	0.70	1.50
Disgust	3.07	1.69	1.48	2.18	2.82	2.46	1.25	2.83

Over the 100ms epoch there were significant differences found at the Fz (Disgust: $F(3,35) = 3.22$ $p=0.04$, $\eta p2=.19$) and Cz (Neutral: $F(3,35) = 4.32$ $p=0.01$, $\eta p2=.22$; Disgust: $F(3,35) = 3.05$ $p=0.04$, $\eta p2=.18$)

measurement sites (see Appendix S for comprehensive results). Post hoc tests (Bonferroni correction) revealed that across the 3 significant differences, all the results were found between LAM/LAF or HAM/LAF groups (see Appendix T for all p values) and could demonstrate evidence for sex differences in processing. Thus, suggesting that the utilisation of varying analysis methods can have an effect on the significance of results.

Over the 200ms epoch there were differences found at the Fz (Neutral: $F(3,35) = 4.02$ $p=0.02$, $\eta p2=.21$; Violent: $F(3,35) = 4.06$ $p=0.01$, $\eta p2=.22$; Disgust: $F(3,35) = 4.44$ $p=0.01$, $\eta p2=.23$), Fcz (Neutral: $F(3,35) = 2.92$ $p=0.05$, $\eta p2=.18$; Violent: $F(3,35) = 5.35$ $p<0.01$, $\eta p2=.25$) and Pz (Neutral: $F(3,35) = 4.22$ $p=0.01$, $\eta p2=.22$; Violent: $F(3,35) = 3.81$ $p=0.02$, $\eta p2=.21$; Disgust: $F(3,35) = 3.28$ $p=0.03$, $\eta p2=.19$) measurement sites. Post hoc tests (Bonferroni correction) revealed that across the 8 significant differences, the majority (n=7) were between HAM/LAF or HAF/HAM groups (see Appendix R for all p values) and could demonstrate evidence for sex differences in processing. However, there was a significant difference found between HAM/LAM towards violent ($p=0.01$, $d=1.58$) images in the Fcz. This could demonstrate that over the 200ms epoch there was within-sex evidence (for males only) of a significant difference in response that was moderated by total trait aggression scores. The LAM group responded with significant increased activation that was negative in polarity in comparison to the HAM group who showed slight positive mean activation. This demonstrated that trait aggression potentially moderated response towards violent content in the 200ms epoch between high and low scoring males.

Significant differences were found over the 300ms epoch at the Cz (Violent: $F(3,35) = 3.44$ $p=0.03$, $\eta p2=.20$) and Pz (Violent: $F(3,35) = 6.28$ $p<0.01$, $\eta p2=.27$; Disgust: $F(3,35) = 3$ $p=0.05$, $\eta p2=.18$) measurement sites for the 300ms epoch. Post hoc tests (Bonferroni correction) revealed that across the 3 significant differences, all the results were found between LAM/LAF or LAM/HAF groups and could demonstrate evidence for sex differences in processing.

Over the ELPP epoch there were differences found only at the Pz (Violent: $F(3,35) = 3.41$ $p=0.03$, $\eta p2=.19$; Erotic: $F(3,35) = 5.84$ $p<0.01$, $\eta p2=.26$) measurement sites. Post hoc tests (Bonferroni correction) demonstrated that across the 8 significant differences, the majority (n=3) were between HAF/LAM groups (see Appendix T for p values) and could demonstrate evidence for sex differences in processing. However, over the parietal region there was one significant difference found between HAM/ LAM groups towards erotic ($p<0.01$, $d=1.83$) content. This could demonstrate that over the ELPP epoch there was within-sex evidence (for males only) of differences in response towards erotic content that was moderated by total trait aggression score. It was found that those in the HAM group responded with a significantly increased positive ERP amplitude in comparison to those in the LAM group towards erotic content. This demonstrated that there were differences moderated by trait aggression score in response to erotic content (for males only) across the ELPP epoch.

Over the LLPP epoch there were differences found at the Pz (Violent: $F(3,35) = 3.33$ $p=0.03$, $\eta p2=.19$; Erotic $F(3,35) = 6.02$ $p<0.01$, $\eta p2=.27$) measurement site. Post hoc tests (Bonferroni correction) demonstrated that across the 3 significant differences 2 were between HAF/HAM and HAF/LAM groups (see Appendix AE for p values) and could demonstrate evidence for sex differences in processing. However, there was one significant difference found between HAF/ LAF groups towards erotic ($p=0.01$, $d= 2.43$) content. This could demonstrate that over the LLPP epoch there was within-sex evidence of differences in response towards erotic content that was moderated by total trait aggression score. Those in the HAM group responded with a significantly increased positive ERP amplitude in comparison to those in the LAM group. This demonstrated that there were differences moderated by trait aggression score in response to erotic content across the LLPP epoch for males only. A visual representation has been provided using ERP waveforms below (see Figures 190 – 205).

Males

High Aggression

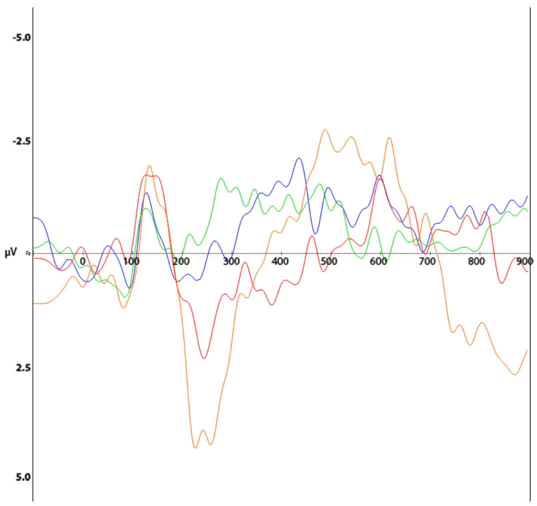


Figure 190. Grand average ERP waveform (microvolts) for HAM at the

Low Aggression

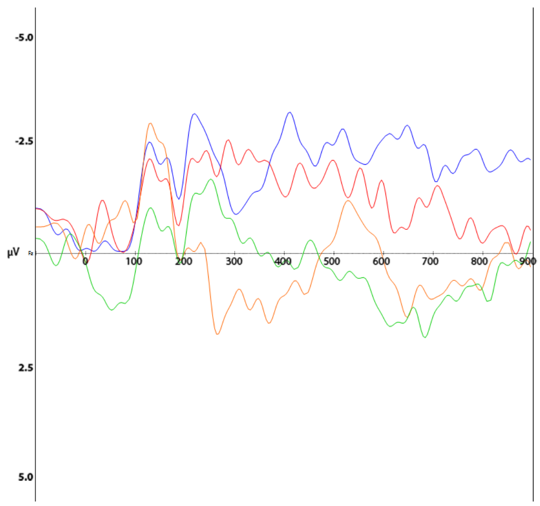


Figure 191. Grand average ERP waveform (microvolts) for LAM at the

Fz location, across time (milliseconds).

Fz location, across time (milliseconds).

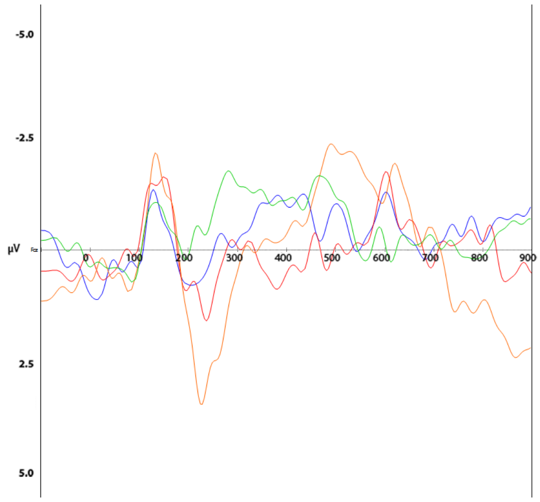


Figure 192. Grand average ERP waveform (microvolts) for HAM at the Fcz location, across time (milliseconds).

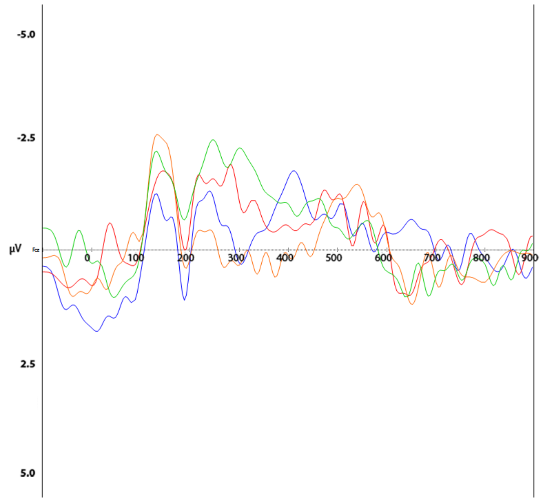


Figure 193. Grand average ERP waveform (microvolts) for LAM at the Fcz location, across time (milliseconds).

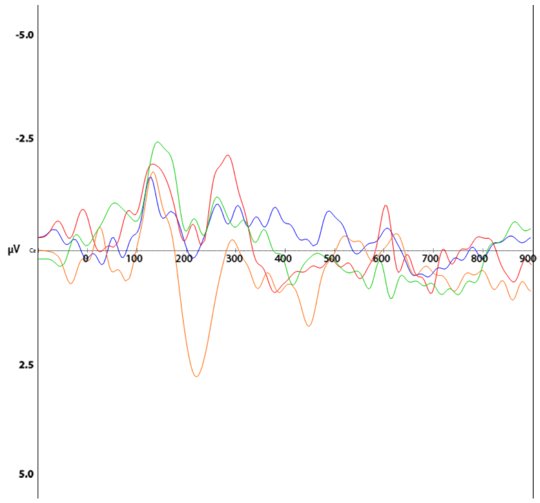


Figure 194. Grand average ERP waveform (microvolts) for HAM at the Cz location, across time (milliseconds).

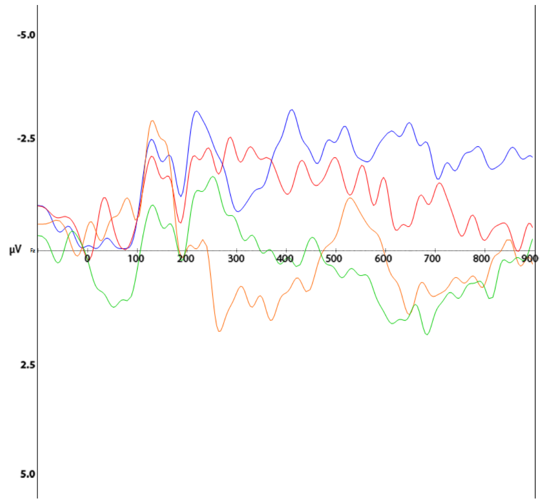


Figure 195. Grand average ERP waveform (microvolts) for LAM at the Cz location, across time (milliseconds).

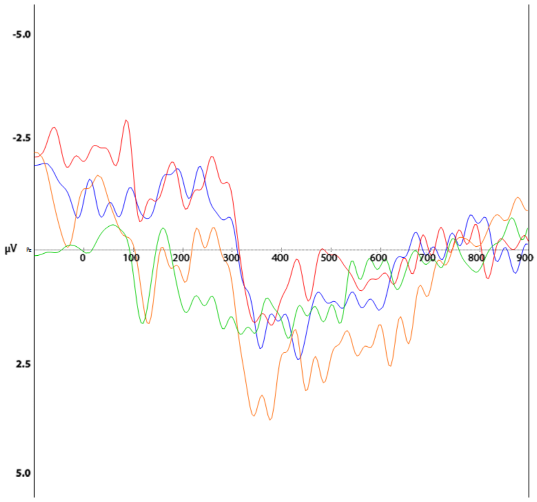


Figure 196. Grand average ERP waveform (microvolts) for HAM at the Pz location, across time (milliseconds).

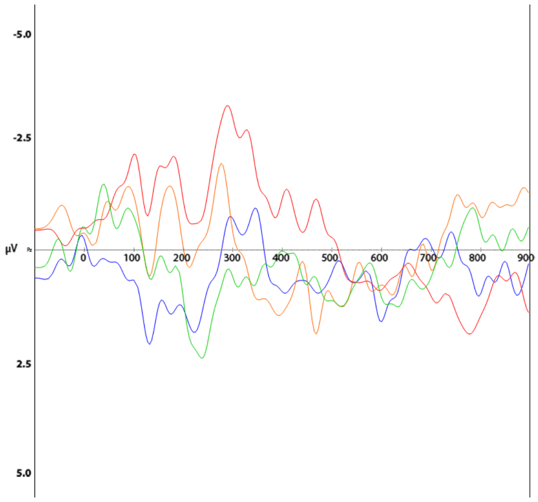


Figure 197. Grand average ERP waveform (microvolts) for LAM at the Pz location, across time (milliseconds).

Neutral
Violent
Erotic
Disgust

Females

High Aggression

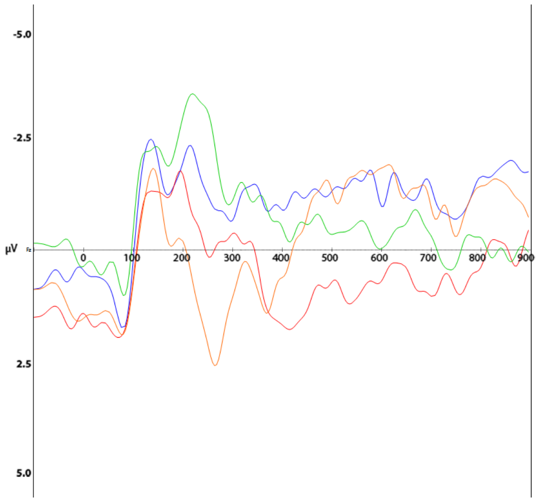


Figure 198. Grand average ERP waveform (microvolts) for HAF at the Fz location, across time (milliseconds).

Low Aggression

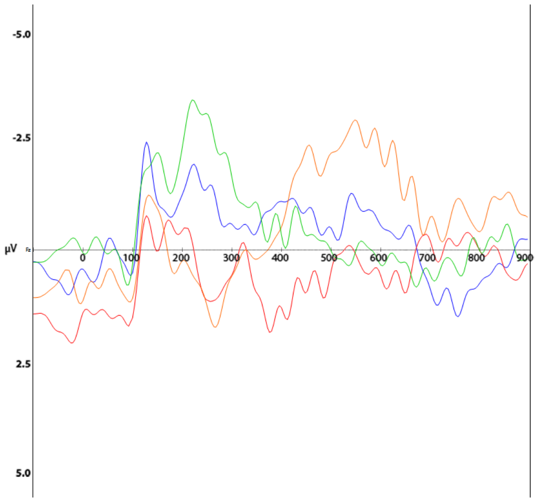


Figure 199. Grand average ERP waveform (microvolts) for LAF at the Fz location, across time (milliseconds).

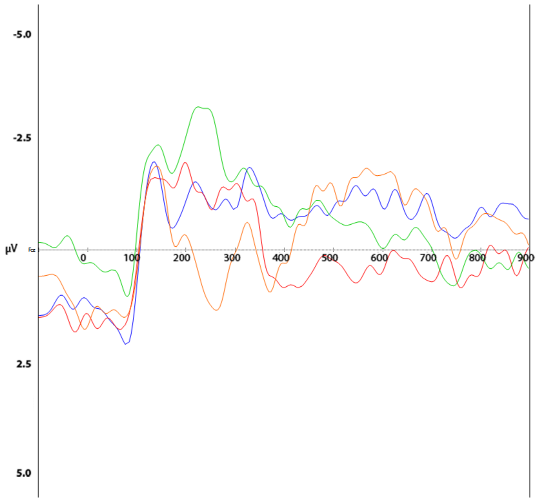


Figure 200. Grand average ERP waveform (microvolts) for HAF at the Fcz location, across time (milliseconds).

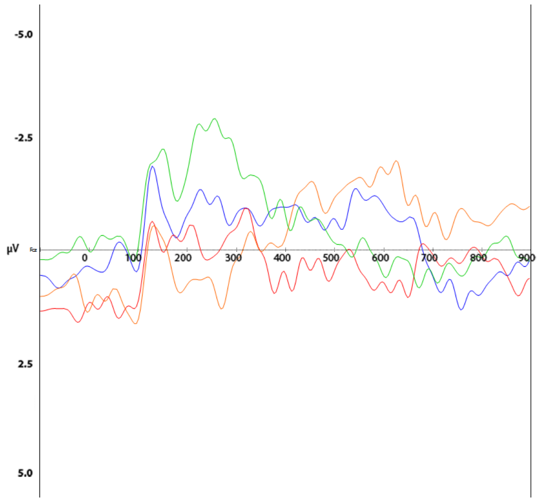


Figure 201. Grand average ERP waveform (microvolts) for LAF at the Fcz location, across time (milliseconds).

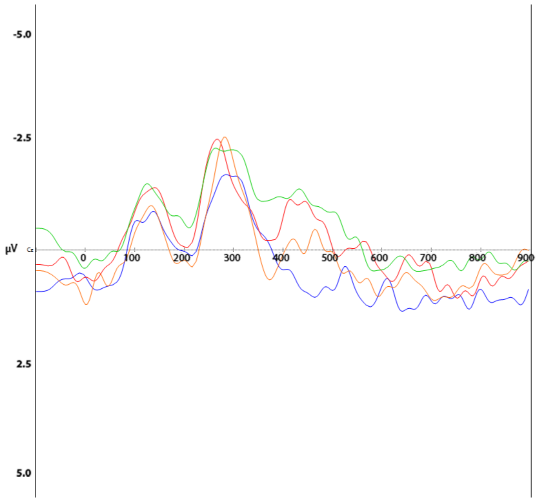


Figure 202. Grand average ERP waveform (microvolts) for HAF at the Cz location, across time (milliseconds).

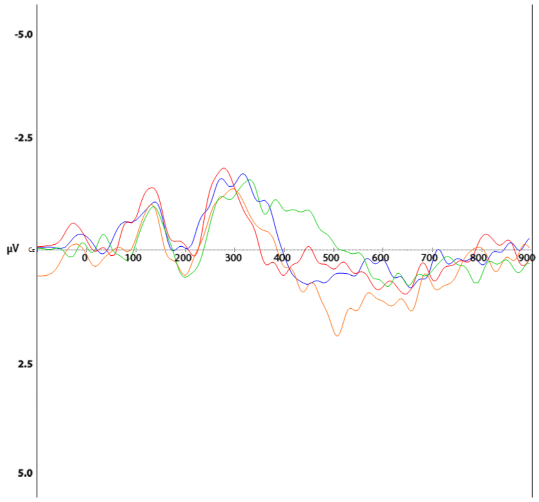
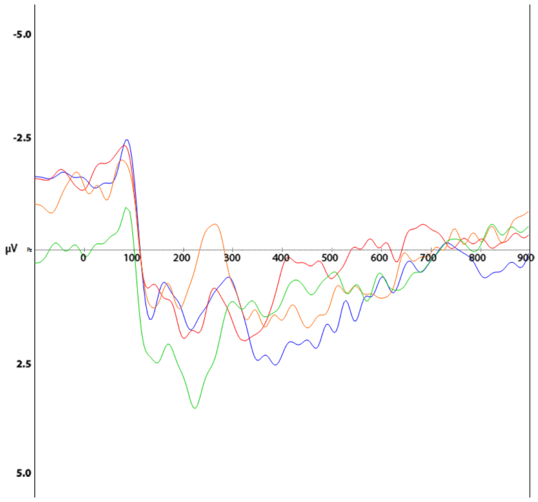


Figure 203. Grand average ERP waveform (microvolts) for LAF at the Cz location, across time (milliseconds).



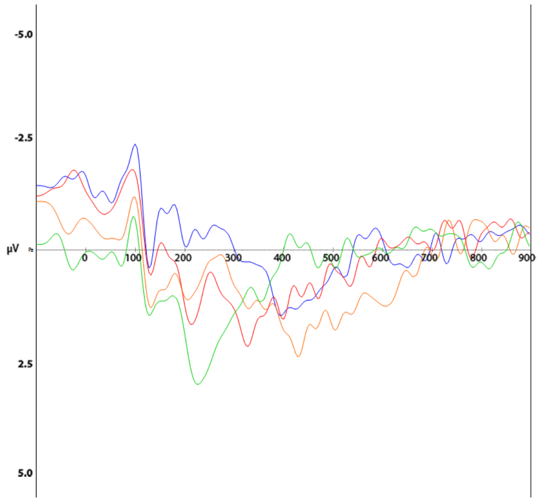


Figure 204. Grand average ERP waveform (microvolts) for HAF at the Pz location, across time (milliseconds).

Figure 205. Grand average ERP waveform (microvolts) for LAF at the Pz location, across time (milliseconds).

5.5.4 Method 6: Trait Aggression (K-Clustering)

K-Clustering was used to automatically select two groups of clustered total aggression scores. This method maximised ($F(1,76) = 192.91$ $p<0.01$) the differences among participant scores on trait aggression. The following data tables (Tables 99 - 103) were collated using the clustered data to define the groups for high or low scores on the Buss and Perry (1992) Aggression Questionnaire by location and epoch to affective images. Total aggression score means and standard deviations were similar across high (HAF mean=88.67, SD=7.62; HAM mean=89.5, SD=7.26) and low groups (LAF mean= 44.17, SD=6.92; LAM mean=48.14, SD=4.26) however, standard deviations were marginally larger for the high scoring groups in comparison to the low scoring groups demonstrating a larger variance around the mean. There was no within sex analysis conducted as group membership was the same across each analysis.

5.5.4.1 50 – 150ms Post Stimuli (100ms)

Table 99. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 100ms timeframe.

100ms	High Aggression Females (n=9)		High Aggression Males (n=12)		Low Aggression Females (n=21)		Low Aggression Males (n=34)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.48	1.91	-0.10	2.36	-1.01	2.08	-0.62	1.01
Violent	-1.84	1.68	-1.24	1.65	-1.10	1.82	-1.22	1.19
Erotic	-0.84	2.54	-1.20	2.38	-1.06	2.52	-2.00	2.07
Disgust	-1.26	1.87	-0.39	1.32	-1.68	1.78	-0.59	1.71
Fcz								

Neutral	-1.70	1.70	-0.60	1.70	-1.26	1.77	-1.33	0.96
Violent	-2.01	1.47	-1.28	1.54	-1.18	1.54	-1.78	0.90
Erotic	-1.22	1.90	-1.28	2.00	-1.10	2.04	-2.28	2.05
Disgust	-1.61	1.61	-0.77	1.10	-1.73	1.69	-1.39	1.89
Cz								
Neutral	-0.56	0.93	-1.70	1.52	-1.07	1.56	-2.15	0.76
Violent	-0.86	1.41	-1.44	1.53	-1.18	1.33	-2.35	0.85
Erotic	-0.77	0.96	-1.56	1.18	-0.83	1.31	-1.53	0.98
Disgust	-1.02	1.11	-1.08	1.34	-1.26	1.11	-1.67	1.45
Pz								
Neutral	0.97	1.68	-0.44	2.70	0.36	2.10	-1.19	1.99
Violent	1.10	1.38	-0.34	2.04	0.19	1.50	-1.36	3.06
Erotic	0.55	2.54	-0.17	1.53	0.90	1.71	-0.47	1.53
Disgust	0.82	1.70	0.47	2.85	0.23	2.12	-0.11	2.18

5.5.4.2 150 – 250ms Post Stimuli (200ms)

Table 100. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 200ms timeframe.

200ms	High Aggression Females (n=9)		High Aggression Males (n=12)		Low Aggression Females (n=21)		Low Aggression Males (n=34)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-4.04	2.89	-1.82	3.51	-2.59	4.00	-1.76	2.11
Violent	-2.95	1.86	-1.04	4.12	-0.96	4.61	-2.18	2.89
Erotic	0.81	3.43	1.70	4.50	0.71	5.51	-0.43	1.55
Disgust	-2.97	2.66	-0.83	4.16	-2.18	3.27	-1.74	1.91
Fcz								

Neutral	-3.86	2.34	-2.20	3.04	-2.33	3.49	-2.31	1.78
Violent	-3.45	1.37	-1.42	3.93	-1.34	3.51	-2.86	2.99
Erotic	-0.02	2.84	1.31	4.03	0.07	4.08	-1.39	1.50
Disgust	-3.09	2.36	-1.16	3.93	-2.06	3.03	-2.19	1.88
Cz								
Neutral	-0.04	2.10	-2.03	3.18	-0.04	1.76	-1.20	2.00
Violent	-0.60	2.38	-2.37	4.15	-0.40	1.59	-3.15	2.29
Erotic	-0.04	1.90	0.23	3.42	0.26	1.79	-0.69	0.96
Disgust	-0.32	1.67	-1.08	3.74	-0.64	1.21	-1.17	2.51
Pz								
Neutral	3.92	2.84	1.14	2.81	2.60	3.51	0.90	2.26
Violent	3.41	2.90	-0.24	2.37	2.04	2.76	-0.85	3.69
Erotic	1.71	2.74	0.33	2.70	1.99	2.45	0.00	1.98
Disgust	3.29	2.15	0.61	3.67	1.37	3.62	1.50	1.87

5.5.4.3 250 – 450ms Post Stimuli (300ms)

Table 101. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 300ms timeframe.

300ms	High Aggression Females (n=9)		High Aggression Males (n=12)		Low Aggression Females (n=21)		Low Aggression Males (n=34)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-2.48	3.17	-1.58	3.48	-1.59	4.13	-1.26	1.62
Violent	-0.79	3.12	-0.39	5.70	0.22	5.45	-1.61	3.37
Erotic	1.00	5.59	0.65	4.30	-0.54	5.61	1.37	1.31
Disgust	-2.27	3.42	-1.40	3.24	-1.77	4.91	-1.13	1.45
Fcz								

Neutral	-3.07	2.57	-2.23	3.13	-2.24	3.47	-2.54	1.65
Violent	-2.03	2.42	-1.09	5.28	-1.02	4.36	-2.84	4.33
Erotic	-0.16	4.43	0.12	3.62	-1.42	4.44	-0.49	1.31
Disgust	-3.00	2.75	-1.64	3.04	-2.31	4.37	-2.51	1.84
Cz								
Neutral	-1.47	1.90	-2.19	3.53	-1.50	2.06	-2.57	2.25
Violent	-0.70	3.00	-1.99	4.17	-0.68	2.06	-4.67	2.77
Erotic	-0.42	2.45	-0.11	3.18	-0.19	2.36	-1.51	1.80
Disgust	-0.85	2.18	-1.14	3.37	-0.87	2.31	-2.97	2.21
Pz								
Neutral	2.49	2.19	1.41	2.85	1.62	2.98	-0.37	2.12
Violent	3.85	3.30	1.68	2.69	2.70	2.83	-1.90	3.77
Erotic	2.69	3.54	3.04	3.26	3.56	2.67	0.56	2.69
Disgust	3.88	2.21	3.25	4.09	2.73	4.07	0.39	2.27

5.5.4.4 450 – 650ms Post Stimuli (ELPP)

Table 102. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the ELPP timeframe.

ELPP	High Aggression Females (n=9)		High Aggression Males (n=12)		Low Aggression Females (n=21)		Low Aggression Males (n=34)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-1.55	3.26	-1.08	3.43	-0.13	3.56	-0.12	1.66
Violent	-0.02	3.15	-1.18	4.96	0.53	4.37	-1.40	2.39
Erotic	-0.85	7.29	-3.54	5.86	-2.97	5.95	-0.50	2.25
Disgust	-2.10	4.12	-3.11	4.52	-1.71	4.71	-0.98	1.64
Fcz								

Neutral	-1.98	2.61	-1.65	3.09	-0.80	2.91	-1.32	1.82
Violent	-0.94	2.29	-1.48	4.67	-0.32	3.59	-2.43	2.99
Erotic	-1.26	5.70	-3.21	5.38	-2.39	4.68	-1.57	2.06
Disgust	-2.25	2.91	-2.83	4.13	-1.72	4.26	-1.86	1.62
Cz								
Neutral	-0.47	1.62	-0.85	2.96	-0.16	1.39	-0.73	2.27
Violent	0.65	3.45	-0.28	3.03	0.56	1.64	-3.18	1.91
Erotic	0.69	3.18	0.08	2.95	1.84	1.64	-0.44	2.57
Disgust	0.85	2.63	-0.59	2.67	0.99	2.36	-0.65	2.20
Pz								
Neutral	2.28	1.97	2.08	2.60	1.44	2.55	0.53	2.97
Violent	3.65	3.66	3.58	2.27	2.47	1.99	-0.37	2.61
Erotic	2.89	4.05	5.34	2.60	4.72	2.57	1.51	2.31
Disgust	4.41	2.15	4.14	3.69	3.14	3.16	1.76	3.20

5.5.4.5 650 – 850ms Post Stimuli (LLPP)

Table 103. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females scoring high or low in total aggression on the Buss and Perry (1992) Aggression Questionnaire, across Fz, Fcz, Cz and Pz, measurement sites for each image category for the LLPP timeframe.

LLPP	High Aggression Females (n=9)		High Aggression Males (n=12)		Low Aggression Females (n=21)		Low Aggression Males (n=34)	
Region and Image Category	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fz								
Neutral	-0.82	2.46	-0.57	3.52	0.34	3.09	0.69	1.20
Violent	0.63	2.96	-0.95	3.83	0.43	3.29	-1.01	1.79
Erotic	-0.87	7.31	-2.66	3.75	-2.68	4.57	0.97	1.87
Disgust	-1.98	4.59	-2.22	3.71	-1.03	2.63	-1.06	1.48
Fcz								

Neutral	-0.95	2.05	-0.86	3.02	-0.17	2.58	-0.23	1.19
Violent	-0.14	2.10	-0.96	3.51	-0.08	2.77	-1.33	1.91
Erotic	-0.94	6.15	-2.30	3.41	-2.10	3.42	0.18	1.51
Disgust	-2.01	3.31	-1.83	3.34	-1.09	2.28	-1.70	1.28
Cz								
Neutral	-0.09	1.18	0.03	2.30	0.34	1.22	-0.08	1.22
Violent	0.99	3.30	0.17	2.31	0.63	1.47	-1.48	1.50
Erotic	0.57	2.88	0.30	1.83	1.43	1.38	0.76	2.50
Disgust	1.10	2.39	0.46	2.00	0.99	1.59	-0.24	0.93
Pz								
Neutral	1.51	1.37	1.72	2.60	1.11	1.89	0.43	2.76
Violent	2.87	3.55	2.55	1.74	1.75	1.79	-0.07	2.76
Erotic	1.55	3.19	3.51	1.93	3.17	2.06	0.89	1.51
Disgust	3.60	2.19	2.93	3.06	2.43	2.54	1.17	2.66

Across the 100ms epoch, significant differences were found at the Cz (Neutral: $F(3,77) = 5.09$ $p<0.01$, $\eta p2=.15$; Violent: $F(3,77) = 2.73$ $p=0.05$, $\eta p2=.05$; Erotic: $F(3,77) = 2.98$ $p=0.04$, $\eta p2=.10$) and Pz (Neutral: $F(3,77) = 3.03$ $p=0.03$, $\eta p2=.10$; Violent: $F(3,77) = 4.73$ $p<0.01$, $\eta p2=.14$) measurement sites. Post hoc tests (Bonferroni correction) revealed that across the 5 significant differences all were between LAM/HAF or HAF/HAM groups (see Appendix V for all p values) and therefore could demonstrate evidence for sex differences in processing.

Significant differences were found at the Cz (Neutral: $F(3,77) = 3.67$ $p=0.02$, $\eta p2=.11$; Violent: $F(3,77) = 3.22$ $p=0.03$, $\eta p2=.10$) and Pz (Neutral: $F(3,77) = 4.73$ $p<0.01$; Violent: $F(3,77) = 9.69$ $p<0.01$, $\eta p2=.22$; Disgust: $F(3,77) = 3.5$ $p=0.02$, $\eta p2=.15$) measurement sites for the 200ms epoch. Post hoc tests (Bonferroni correction) revealed that across the 6 significant differences all were between LAM/HAF or HAF/HAM groups (see Appendix V for all p values) and therefore could demonstrate evidence for sex differences in processing.

Over the 300ms epoch there were differences found at the Cz (Neutral: $F(3,35) = 4.02$ $p=0.02$, $\eta p2=.03$; Violent: $F(3,35) = 4.06$ $p=0.01$, $\eta p2=.12$) and Pz (Neutral: $F(3,35) = 4.22$ $p=0.01$, $\eta p2=.09$; Violent: $F(3,35) = 3.81$ $p=0.02$, $\eta p2=.20$) measurement sites. Post hoc tests (Bonferroni correction) revealed that across the 7 significant differences, the majority (n=6) were between HAM/LAF or HAF/HAM groups (see

Appendix V for all p values) and therefore, could demonstrate evidence for sex differences in processing. However, there was a significant difference found between HAM/LAM towards violent ($p=0.01$, $d=1.59$) images in the parietal region. This could demonstrate that over the 300ms epoch there was within-sex evidence (for males only) of a significant difference in response that was moderated by total trait aggression scores. The LAM group responded with significant increased activation that was negative in polarity in comparison to the HAM group who showed positive mean activation. This demonstrated that trait aggression potentially moderated response towards violent content in the 300ms epoch between high and low scoring males.

Across the ELPP epoch there were differences found at the Cz (Violent: $F(3,77) =4.45$ $p=0.01$, $\eta p2=.12$) and Pz (Violent: $F(3,77) =5.34$ $p<0.01$, $\eta p2=.15$; Erotic: $F(3,77) =4.85$ $p<0.01$, $\eta p2=.14$) measurement sites. Post hoc tests (Bonferroni correction) revealed that across the 7 significant differences, the majority (n=6) were between HAM/LAF, LAF/LAM or HAF/HAM groups (see Appendix V for all p values) and therefore, could demonstrate evidence for sex differences in processing. However, there was a significant difference found between HAM/LAM towards violent ($p<0.01$, $d=1.61$) and erotic ($p=0.01$, $d=1.56$) images in the parietal region. This could demonstrate that over the ELPP epoch there was within-sex evidence (for males only) of a significant difference in response that was moderated by total trait aggression scores. The HAM group responded with significant increased positive activation in comparison to the LAM. This demonstrated that trait aggression potentially moderated response towards violent and erotic content in the ELPP epoch between high and low scoring males.

Over the LLPP epoch there were differences found over the parietal region in response to violent ($F(3,77) =3.16$ $p=0.03$, $\eta p2=.10$) and erotic ($F(3,77) =4.6$ $p=0.01$, $\eta p2=.14$) images. Post hoc tests (Bonferroni correction) revealed that across the 3 significant differences, 2 of them were between HAM/LAF or HAF/HAM groups (see Appendix V for all p values) and therefore, could demonstrate evidence for sex differences in processing. However, there was a significant difference found between HAM/LAM towards erotic ($p=0.04$, $d=1.51$) images in the parietal region. This could demonstrate that over the LLPP epoch there was within-sex evidence (for males only) of a significant difference in response that was moderated by total trait aggression scores. The HAM group responded with significant increased positive amplitude in comparison to the LAM (see Table 89.). This demonstrated that trait aggression potentially moderated response towards erotic content in the LLPP epoch between high and low scoring males. A visual representation has been provided using ERP waveforms below (see Figure 206 - 221).

Males

High Aggression

Low Aggression

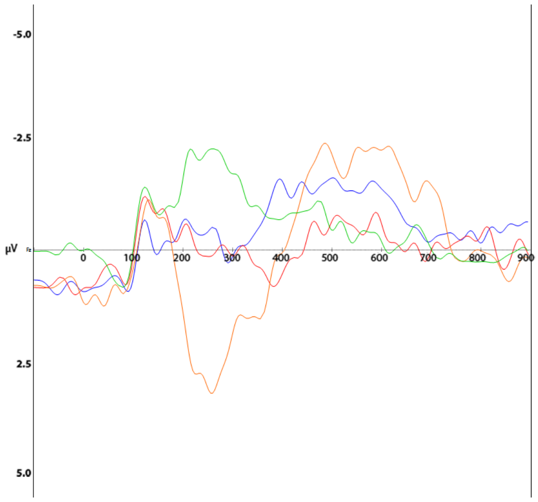


Figure 206. Grand average ERP waveform (microvolts) for HAM at the Fz location, across time (milliseconds).

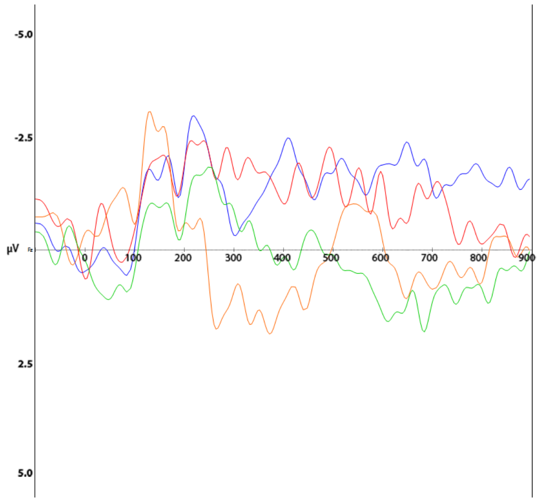


Figure 207. Grand average ERP waveform (microvolts) for LAM at the Fz location, across time (milliseconds).

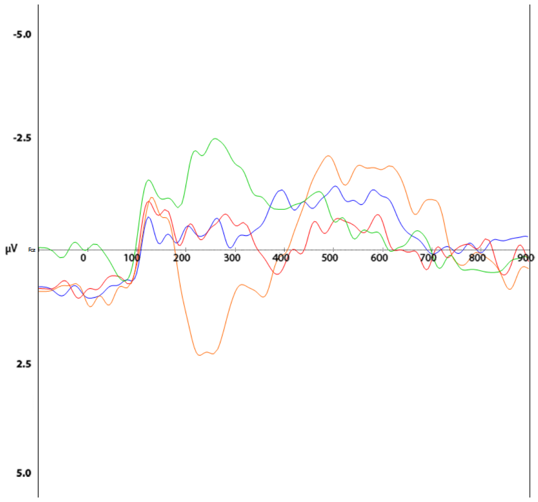


Figure 208. Grand average ERP waveform (microvolts) for HAM at the Fcz location, across time (milliseconds).

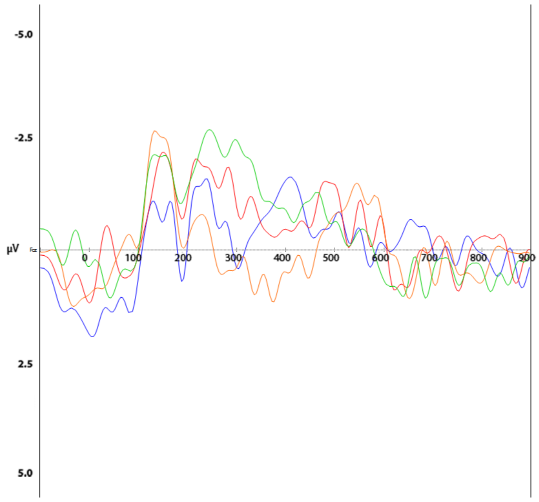


Figure 209. Grand average ERP waveform (microvolts) for LAM at the Fcz location, across time (milliseconds).

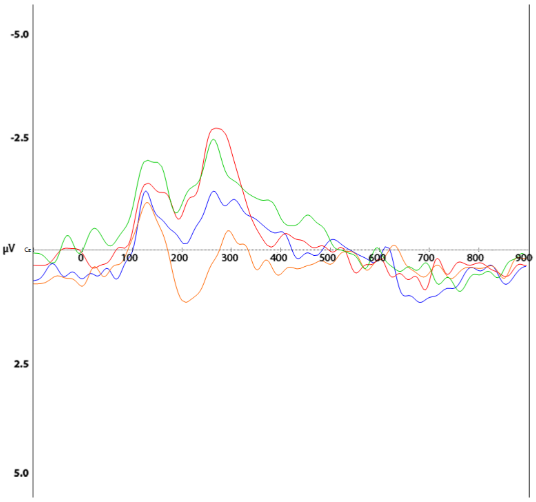


Figure 210. Grand average ERP waveform (microvolts) for HAM at the Cz location, across time (milliseconds).

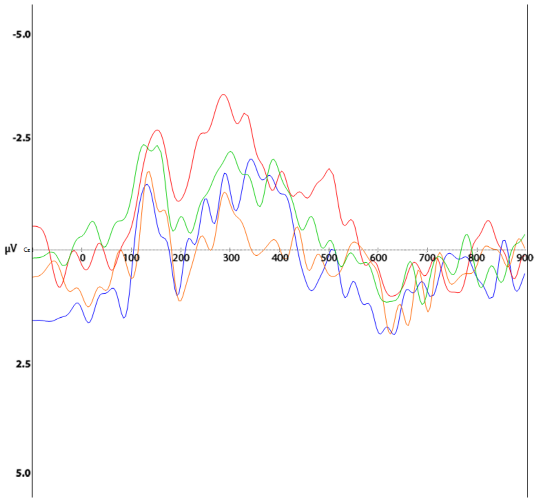


Figure 211. Grand average ERP waveform (microvolts) for LAM at the Cz location, across time (milliseconds).

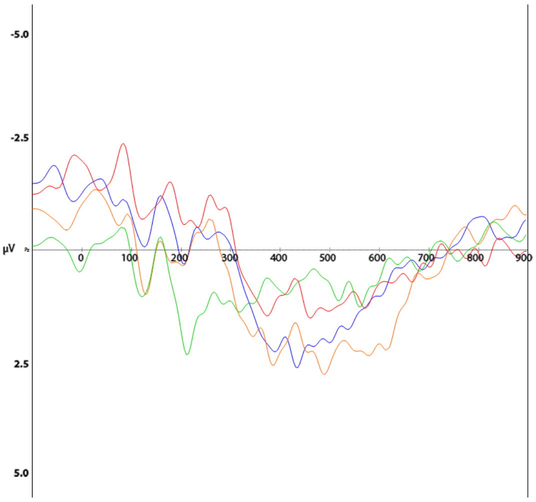


Figure 212. Grand average ERP waveform (microvolts) for HAM at the Pz location, across time (milliseconds).

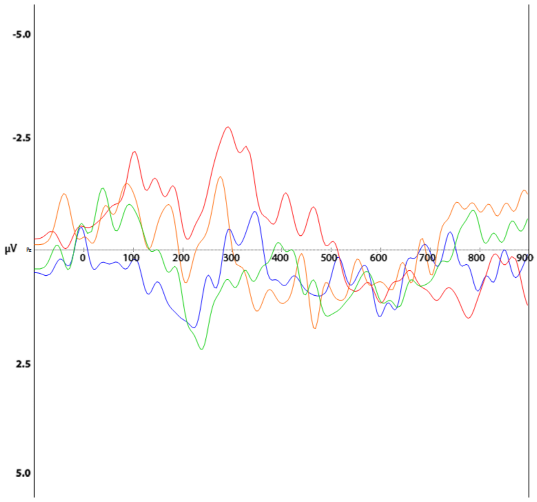


Figure 213. Grand average ERP waveform (microvolts) for LAM at the Pz location, across time (milliseconds).

Females

High Aggression

Low Aggression

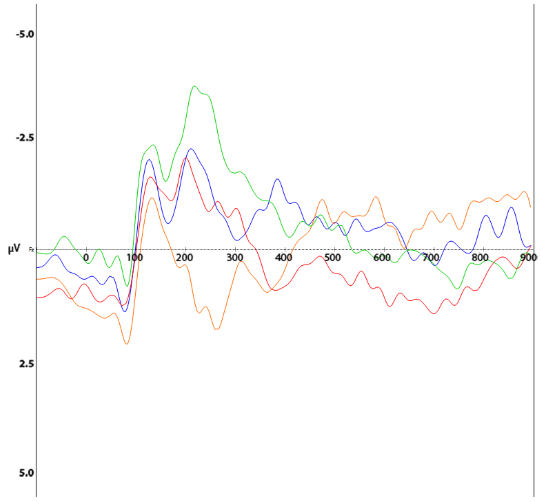


Figure 214. Grand average ERP waveform (microvolts) for HAF at the Fz location, across time (milliseconds).

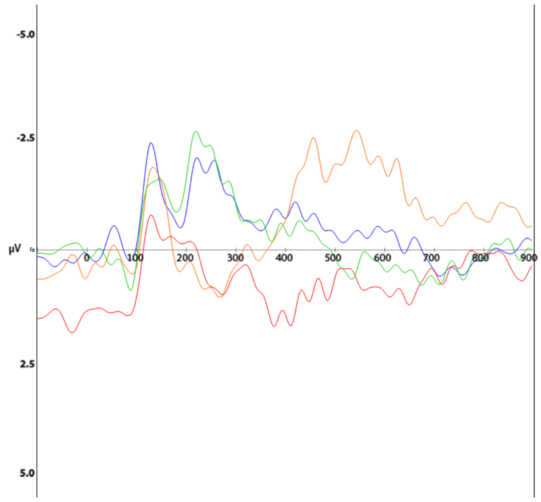


Figure 215. Grand average ERP waveform (microvolts) for LAF at the Fz location, across time (milliseconds).

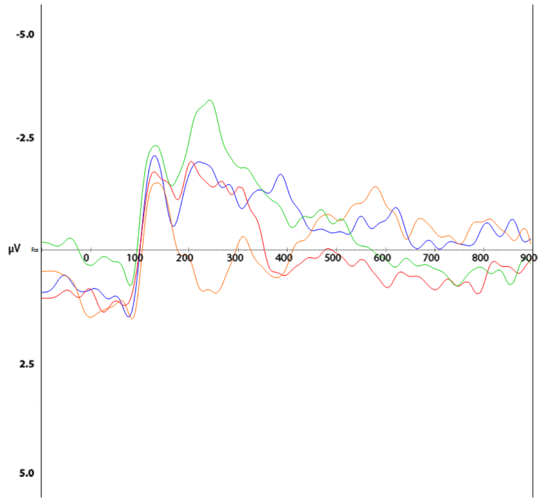


Figure 216. Grand average ERP waveform (microvolts) for HAF at the Fcz location, across time (milliseconds).

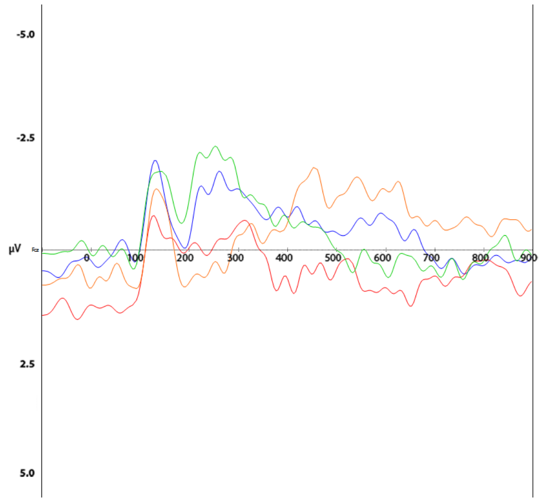


Figure 217. Grand average ERP waveform (microvolts) for LAF at the Fcz location, across time (milliseconds).

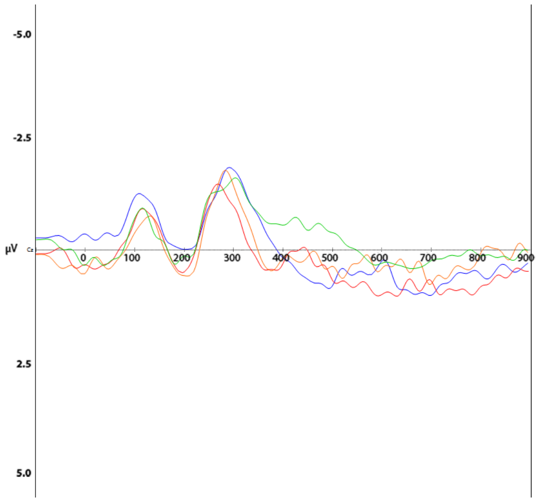


Figure 218. Grand average ERP waveform (microvolts) for HAF at the Cz location, across time (milliseconds).

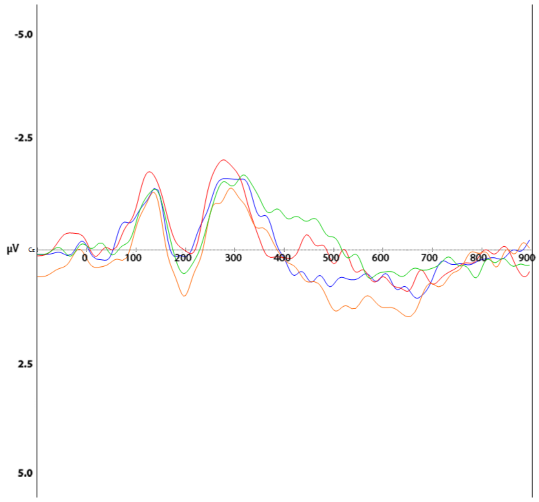


Figure 219. Grand average ERP waveform (microvolts) for LAF at the Cz location, across time (milliseconds).

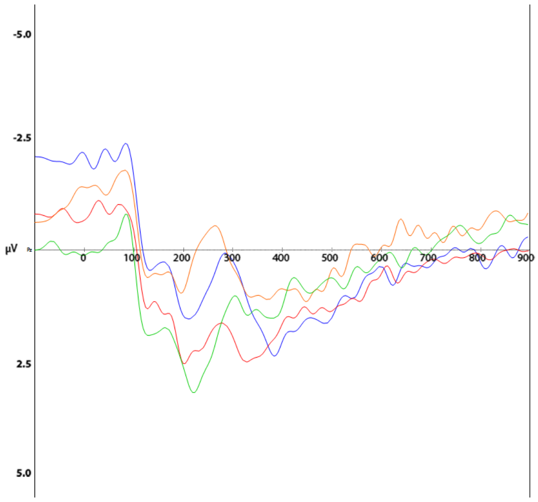


Figure 220. Grand average ERP waveform (microvolts) for HAF at the Pz location, across time (milliseconds).

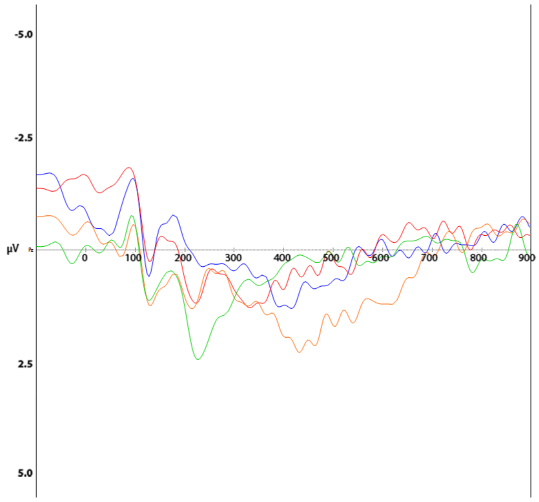


Figure 221. Grand average ERP waveform (microvolts) for LAF at the Pz location, across time (milliseconds).

5.6 Discussion

The aim of this research was two-fold. Firstly, to investigate the differences in ERP activation towards affective media based on total trait aggression scores (both between groups and within-sex) using a standardised psychometric measure of aggression and justified methodology. Secondly, to investigate whether minor changes in data processing (Cut off of 81; Media method; 25th and 75th Percentile or K-Clustering) and raw data allocation for dichotomous variables (High and Low aggression) had on effect on overall ERP results and subsequent meaning of the findings. Based on prior research, there were two hypotheses formed.

It was predicted that there would be significant differences between those in high aggression groups in comparison to those in low aggression groups in response to affective imagery, with significant differences evident between within-sex groups (i.e. differences between high and low females and high and low males) to demonstrate validity, consistency and reliability of the IV trait aggression as measured by the BPAQ (Buss & Perry, 1992). The second prediction was that employing minor variations in data processing would provide discrepancies in results between methods that could lead to differences in interpretation and perhaps provide an explanation for the inconsistency across the media research field.

It should be explained that this process was, by no means, a data mining exercise (the actual results, although very interesting, were somewhat irrelevant in this context i.e. whether or not any of the specific methods adopted supported or refuted previous claims were not a concern in this research). Rather, it aimed to highlight that the field requires standardisation of methodologies and processing procedures in order to accurately, and empirically, offer any real meaning and consistency to the findings that would enable the cross-evaluation of results. However, where current results appeared to converge across methods, their relevance has been discussed.

As predicted overall, across all data processing methods used, results showed that there were differences in ERP amplitude over all epochs and measurement sites in response to all image categories based on total trait aggression score (see Appendix K, M, O, & Q). There appeared to be significant differences between the four trait aggression groups consistently found across the central and parietal sites towards neutral, violent and erotic content (see Appendix K, M, O, Q & S for comprehensive ANOVA results). Thus, if all analysis had have stopped here, these results could be viewed as support for the GAM as there were differences in neurological response towards affective imagery appearing to have been moderated by trait aggression. However, there was a lack of consistency across method, image category (i.e. all violent/erotic/disgust or neutral content) at any specific epoch or measurement site, between high and low trait aggression groups (i.e. all low scorers at a specific measurement site, across a specific epoch in response to any specific image category) and for between high and low scoring trait aggression groups (i.e. all groups), or within sex (i.e. HAF/LAF or HAM/LAM). Therefore, on initial consideration, this research simply showed that there were differences in ERP activation between the aggression groups in response to the differing image categories. In addition, the differences were based on the data processing method employed and could offer no conclusive evidence to support, or refute, the GAM (see Appendix K-AB).

Although there were several significant differences found between trait aggression groups in response to the image categories (see Appendices K to V), the majority could have been explained as sex differences (i.e. differences found between groups; HAM/HAF; HAM/LAF; HAF/LAM; LAM/LAF). Thus, it could not be guaranteed that these results were based on the trait aggression variable and were omitted. However, it did provide support for the continued accommodation for sex as an important factor in research that considers the processing of visual stimuli (e.g. Lithari et al., 2010).

Nonetheless, where the IV (total trait aggression) could show within-sex consistency (i.e. between HAM/LAM or HAF/LAF groups), results demonstrated that the effects were predominantly found between male groups in response to violent and erotic images (with the exception of one towards images of disgust and two in response to neutral content). Thus, suggesting that for males, there were differences in ERP amplitude moderated by trait aggression for both violent and erotic content. To be specific, there were a similar number of differences found in relation to violent as there were in response to erotic content (see Appendices K-AC for extensive tabulated & diagrammatical demonstration of the differences between methods). However, there was a lack of consistency across methods (see Appendix AB for diagrammatical representation of group membership).

Although previous research has claimed that ERP responses in the parietal region over the 300ms epoch towards violent content has identified and shown the link between media exposure and aggression (e.g. Bartholow et al, 2006; Engelhardt, Bartholow, Kerr, et al., 2011), the current research only found one (Method 6: K-Clustering) significant difference across all six method types and it was between HAM and LAM groups. Therefore, this suggested that trait aggression did not modulate ERP activation over the 300ms epoch and was in line with research that has failed to show the link between aggression and the P300 (Surguy & Bond, 2006). Emphasis has been given to the measurement of the P300 component and its reflection of the evaluation of the relevance of stimuli content (i.e. increased P300 amplitudes have been observed for stimuli that were unexpected or inconsistent with current expectation; Schupp et al., 2000; Cacioppo, Crites, Gardner, & Berntson, 1994; Oliver, 2014). Thus, it was possible that participants in the current study may have perceived the stimuli content as expected and relevant therefore responded with similar activation over this epoch.

It was suggested that previous literature in the field had measured a P300 component significantly later than was expected (around 600ms post stimuli presentation) and to account for this delay, the ELPP epoch was added (see Ch 4). Within this epoch there were significant differences found between HAM and LAM for three of the six different data processing methods (see Appendix AB) towards violent content. The HAM group responded with a significantly increased activation (in either polarity) in comparison to the LAM group. Thus, this suggested that there were differences in processing between high and low scoring aggression male groups in response to violent content and could support research that has found links between high trait aggression and increased neural sensitivity towards threat related stimuli (da Cunha-Bang et al., 2017) and suggestions that attention was motivated towards depictions of interest (e.g. Schupp et al., 2004). However, these results can offer no explanation of causality or prediction of behaviour or cognition. It is not known whether the measure of trait aggression moderated response or whether aggression could be linked with increased neurological stimulation towards affective content.

Importantly, there was no consistency in findings between methods. For example, in the 300ms epoch, the LAM group showed significantly increased activation in comparison to the HAM group towards violent content when the data was processed using Method 6: K-Clustering. Yet, in the same epoch, the HAM group responded with significantly increased activation in comparison to the LAM group towards violent content using Method 1: 81 Cut-Off. It would be inappropriate to claim one method was correct in comparison to another without further investigation and clarification. Nonetheless, based on these results, there was no evidence to support the desensitisation effect (Bartholow et al., 2006; Engelhardt, Bartholow, Kerr, et al., 2011). In this particular instance, for this research to support the desenitisation effect there would need to be evidence to demonstrate a significant decreased amplitude for those in the high aggression groups (between and within sex) in comparison to those in the low aggression groups in response to violent content, over the parietal location for the 300ms or ELPP epoch. This was not the case.

Furthermore, this research highlighted the potentially spurious nature of having a variety of data processing methods available as it could provide the option to enable a favourable outcome (Elson, 2016; Elson et al., 2014; Ferguson, 2007; Ferguson & Dyck, 2012; Ferguson, Garza, Jerabeck, Ramos, & Galindo, 2013; Ferguson, Smith, Miller-Stratton, Fritz, & Heinrich, 2008; Ramos, Ferguson, Frailing, & Romero-Ramirez, 2013; Simmons et al., 2011).

There was some convergence across data processing method found in response towards the erotic category in the ELPP. There were significant differences found between HAM and LAM groups for five of the six different data processing methods. HAM responded with a significantly increased activation (in either polarity) in comparison to the LAM group for erotic content over the ELPP epoch. It has been shown that male participants in the high aggression group tended to demonstrate significantly increased ERP activation in response to erotic and violent content at the parietal measurement site. However, again these findings were dependent on method used. Taken together, these results have suggested that there was no individual method that could be identified or adopted as 'best practice' however, unequivocal evidence has been provided that method has an impact on findings and potential interpretation. Therefore, support has been provided for the call for standardised use of methodology (see Ch 2) and for the justified choice (made prior to data collection), and use thereof, data processing techniques and analysis (Elson, 2016)

This research has clearly shown evidence of the variation in results between the findings from each of the data processing methods employed (see Appendices K to AC for across method differences and Appendices V to AC for tabulated & diagrammatical visualisation of differences between methods). Additionally, where the same technique was employed between groups and was subsequently weighted for sex (Methods 3 & 5), there were very little similarities either between the same techniques (Methods 2 & 3 or 4 & 5) or between similar weighted techniques (i.e. Methods 3 & 5). Thus, this supported claims that previous results may have been confounded by the method adopted (e.g. Adachi & Willoughby, 2011, 2013; Elson, 2016; Ferguson & Rueda, 2009; Ferguson, Smith, et al., 2008; Tedeschi & Quigley, 1996, 2000) and could offer a potential explanation for the inconsistencies across the field (e.g. Anderson & Carnagey, 2004, 2009; Bartholow, Bushman, & Sestir, 2006; Bartholow, Sestir, & Davis, 2005; Barnett & Coulson, 2010; Carnagey, Anderson, & Bartholow, 2007; Engelhardt, Bartholow, Kerr, & Bushman, 2011; Engelhardt, Bartholow, & Saults, 2011;; Ferguson, 2007a, 2010; Ferguson & Cricket Meehan, 2010; Ferguson & Dyck, 2012; Ferguson, Olson, Kutner, & Warner, 2014; Ramos, Ferguson, Frailing & Romer-Ramirez, 2013; Savage & Yancey, 2008; Szycik et al., 2017).

It should be noted that previous research has tended to report findings from a specific electrode or in relation to one image category (e.g. Bartholow et al, 2006). Although this decreases the chance of type 1 results in multivariate tests (Field, 2013), it increases the importance of the results. For example, when understanding the results of the differences between groups based on violent content, it may have been viewed as a key finding that there were differences in ERP amplitude over the ELPP epoch between male participants in high and low trait aggression groups, and three of the six data processing methods employed appeared to converge showing significant differences post hoc. However, when those results are understood in a wider perspective (across measurement sites, epochs and different image categories), it can be seen that in relation to for example, erotic content where five of the six methods appeared to converge at the same measurement site and epoch, the finding could be one of a vast score of differences that may recentralise the importance of all the results shown. Thus, by drawing out one element it places interest on just one factor that may overextend the results when compared and understood in relation to a wider perspective. Nonetheless, current findings have suggested that there were significant processing differences towards visual affective stimuli that was moderated by trait aggression across the 200ms, 300ms ELPP and LLPP epochs for male participants. Although, there was little consistency across method (see Appendices K-AC for extensive tabulated & diagrammatical demonstration of the differences between methods).

In a previous chapter (see Ch3.), it was found that there were no significant differences in ERP activation within the female sample, based on trait aggression. Findings were similar here. There were only two significant results found between female groups (across all six methods). Both these were in the LLPP epoch and were in response to erotic and violent image categories in the parietal site. Thus, suggesting that females tended to respond relatively similarly regardless of total aggression score except from in the LLPP epoch where results suggested that affective stimuli were processed differently between aggression groups. The HAF group responded with a significantly increased positive activation towards violent content in comparison to those in the LAF and the LAF group showed significantly increased positive activation towards erotic content in comparison to the HAF group.

Taken overall, the current results have provided evidence of potential within-sex effects moderated by trait aggression that appeared to be sex specific (i.e. for males) except from in the LLPP. This has added to the literature suggesting that there are sex differences in processing (e.g. Glaser, Mendrek, Germain, Lakis, & Lavoie, 2012; Lithari et al., 2010; Lusk, Carr, Ranson, & Felmingham, 2017; Lykins, Meana, & Strauss, 2008; Ruigrok et al., 2014; Rupp & Wallen, 2008; Victor, Drevets, Misaki, Bodurka, & Savitz, 2017). This has provided further evidence that has demonstrated that sex must be treated as an IV within research investigating the processing of visual stimuli. However, with closer investigation, it should be acknowledged there was little consistency to findings across data processing method (see Appendix AB for visual representation). This demonstrated that significance, and to some degree, relevance has been dictated by the data processing method adopted.

It was found that for within-sex differences, the high scoring groups tended to respond with increased ERP amplitude in comparison to the low trait aggression scoring groups towards affective content over the ELPP and LLPP epochs (although this tendency was dependant on method). Across the ELPP epoch it was found that there were significant (within-sex) differences based on the violent category. The HAM group responded with an increased activation in comparison to the LAM group. These findings were in direct contrast to the desensitisation effect however, it has been previously demonstrated that ERP amplitude was responsive to motivated interest (e.g. Schupp et al., 2010) and could suggest that those in the HAM group were more motivated towards this type of affective content. Moreover, it has been suggested that component (e.g. the P300) amplitude and latency was related to the neural allocation of attention and increased efficiency in cognitive function (Godleski et al., 2010; Hillyard, Mangun, Woldorff, & Luck, 1995; Polich, 2007) with evidence of neurological and cognitive impairments linked with aggressive individuals (Barratt, Stanford, Dowdy, Liebman, & Kent, 1999; Barratt, Stanford, Kent, & Felthous, 1997; Bond & Surguy, 2000; Houston & Stanford, 2005; Raine et al., 2004; Raine, Venables, & Mednick, 1997; Stanford et al., 2003).

For example, participants known to be reactive/ impulsive aggressive were shown to respond with a reduced P300 amplitude and increased P300 latency in comparison to proactive /premeditative aggressive and non-aggressive individuals (Barratt et al., 1997; Harmon-Jones, Barratt, & Wigg, 1997). Although Raine, Venables, and Williams (1990) and Raine et al. (1997) have suggested that a slow heart rate was a genetic marker of aggression and some aggressive individuals have demonstrated comparatively stable and average scores on physiological measures (Murray et al., 2016), the current findings may be associated with an increased state of motivated arousal most related to the physiological response and attention (e.g. Nordstrom & Weins, 2012; Schupp et al., 2000). Thus, differences may not support research suggesting that VM and EM are causal of aggression rather that participants in the high trait aggression groups were more stimulated by affective content than those in low aggression groups. However, no measure of physiological arousal was taken. The complexity of this relationship would require further investigation.

Based on the variety of results, this research has also queried the use of the BPAQ measure to identify group membership (e.g. Alia-Klein et al. 2014; Engelhardt, Bartholow, Kerr, et al. 2011; Engelhardt, Bartholow, and Saults, 2011). It could be suggested that the dichotomous grouping of trait aggression leads to the formulation of spurious groups. The 29-item cognitive measure has a range of 115, with total scores falling between 29 – 144 (Buss and Perry, 1992). However, the small band of approximate 10 – 15 points is thought to define the differences between low aggression individuals and violent offenders (Palmer & Thakordas, 2005; P. Smith & Waterman, 2004). It would be expected that a median score of 86.5 (144-29=115/2=57.2 +29 = 86.5) would be viewed as an 'average score' however, this value would suggest that violent bullies and violent offenders obtain scores with a comparable mean average. Thus, potentially it was an inaccurate method of deciphering and assigning group membership due to only a central 9% of the range of scores being where all interest falls. Therefore, this measure could be viewed as an arbitrary measure that fails to accurately quantify differences between groups in this context. Nonetheless, there appears no consensus over an acceptable 'interesting' range of scores and no currently established measure or methodology that has addressed this.

Recently, Paulhus, Curtis, and Jones (2017) questioned the BPAQ regarding its continued use and pivotal position as gold standard measure (Paulhus, Curtis, & Jones, 2017; Paulhus & Williams, 2002). It was suggested that aggression should not be regarded as a unitary trait and moreover, that aggression cannot be fully encapsulated by using such an approach. It was argued that aggression is an intrinsically interactive process whereby individual differences interact with external situations that potentially moderate aggressive cognition and behaviours. These, triggers (moderator elements) have many possible predictors and have been shown to capture daily variance in aggression and feelings of anger (Kashdan, Goodman, Mallard, & DeWall, 2016).

Paulhus, Curtis, & Jones (2017) have suggested that the term aggression should be reserved only for overt outcomes and argued for a bottom up approach where trait aggression is measured using four personality variables or constructs (Machiavellianism, psychopathy, narcissism and sadism) that have been previously mapped to the Big Five Personality traits (Paulhus & Williams, 2002) that demonstrated each construct merited individual measurement. These Dark Tetrad of inter-correlated personality traits have yet to be explored with regards to the cognitive mediators, however, from a behavioural perspective there have been strong links made in the understanding of the complexity of aggressive behaviour (Paulhus et al., 2017; Paulhus & Williams, 2002). Until a true discriminating biometric measure of aggression has been developed, it may be beneficial for future research to explore the neurological basis of aggression and links with personality traits such as the Dark Tetrad in order to further classify and understand the differences moderated by aggression. Most importantly, its use may enable a more valid dichotomy of aggression. This would require extensive further investigation. Therefore, based on the minor group mobility of the data processing method, there can be a variance in results that can impact findings and meaning. This has identified and evidenced the need for consistency in methods and measures across the field. This has shown that without doubt, there is a need for standardisation of measures and methods.

It would be expected that response towards neutral content would be similar regardless of grouping variable (in this case, trait aggression). Interestingly, differences were found across all epochs towards neutral images (see Appendix K – V). As in previous chapters and investigation (see Ch. 3 and 4) this has questioned the neutrality of neutral images provided by the IAPS. Further research would be required to investigate what defines a neutral image and the relevance of the confounded content of IAPS neutral images. It has been acknowledged that selecting stimuli based on arousal and valence ratings alone (e.g. Alpers, Adolph, & Pauli, 2011; Bartholow et al., 2006; Kunaharan, Halpin, Sitharthan, Bosshard, & Walla, 2017; Lang et al., 2008; Lithari et al., 2010; Polackova & Lacev, 2017; Zheng et al., 2015) can be inadequate (e.g. Anokhin et al., 2006). However, the impact of the highly confounded content of each image category could explain the significant differences found across trait aggression groups and could have modified the relevance of previous research that has used the IAPS catalogue for stimuli.

Image content such as faces (Fan et al., 2015) or figures (Nordström & Wiens, 2012) and stimuli colour (Cano et al., 2009) have all been shown to modify ERP response. It has been suggested that stimuli with faces or figures present have more focused processing and attention in comparison scenes (Clayson & Larson, 2013; Nordström & Wiens, 2012). Therefore, where measurement of biological responses in relation to visual stimuli are expected, the IAPS has limited value. Every image has multiple, hidden confounding variables (e.g. content confounds: face (Bistricky et al., 2014; Fan et al., 2015; Moradi, Mehrinejad, Ghadiri, & Rezaei, 2017), figures (Nordström & Wiens, 2012), real or posed (Ramos et al., 2013), socially current/ outdated norms (clothing and grooming), image properties: resolution (Boom, Beumer, Spreeuwers, & Veldhuis, 2006; De Cesarei, Mastria, & Codispoti, 2013; Peterson & Wolffsohn, 2005), basic photography rules (Davis, 2011; Sahlin, 2011), over/ under exposure (Schupp, Junghofer, et al., 2004) and associated levels of IV thereof) that can modify response. In addition to contaminated stimuli, there are several response differences that have shown to be potential products of individual differences (e.g. preference, motivation, perception, memory), biological (threat perception, disgust aversion, reproduction) and defining participant criteria that should be considered key factors and variables (e.g. sex, age). Thus, these highlighted factors should be viewed as limitations of this study as there has been no accommodation for alternative factors, except from sex.

Therefore, future research requires investment in a stimuli catalogue that aims to remove layers of confound (it is accepted that it may be impossible to account for all differences in preference as the image sample size would likely be infinite) and initially begins investigation of simple key factors that have been shown to consistently modulate response for example, sex differences. As any further surmising of causality links between media content and subsequent behaviour would be futile and potentially provide meaningless results without empirical, valid and robust identification and attribution of effects.

In summary, the current research has demonstrated on a very basic level that minor variation in participant allocation and/or data analysis strategy and technique can significantly modify results. Thus, clearly an accepted standardised methodology and analysis is required within the field to truly establish meaningful, cross referenceable results as there is currently no consensus across author, academic group or publisher. Therefore, this has identified and established that based on the use of standardised methodology, replicability appears low among results and thus, this has questioned the validity of a multimethod (cross methodology and especially data analysis) adoption across the field. It has added to the literature suggesting that there are significant sex differences in visual processing and furthermore had shown that here was a within sex effect of trait aggression that was specific to male participant groups. It also highlighted the potential issue with psychometric measures of aggression being used to formulate grouping variables. In addition, this research has re-emphasised a key limitation regarding the presented stimuli content. This requires further consideration regarding the effects of known attention and processing modulators that can be considered confounds of image categories. For the future, research should work towards the development of an appropriate stimuli catalogue and a discriminating measure of aggression (e.g. biometric) however, both were beyond the scope of the current thesis

5.7 Key Findings

There was little convergence between data processing method adopted.

Significance of results were dependant on data processing method adopted. This has the potential to lead to the selection of the method to enable a favourable outcome that seeks to support hypotheses.

There was no evidence for the desensitisation effect.

There was evidence to suggest that trait aggression moderated ERP response towards visual stimuli (Erotic, Violent, Disgust and Neutral).

There was a within-sex effect that appeared to only be for male participants.

Those in the high aggression groups predominantly responded with an increased ERP amplitude in comparison to those in the low aggression groups towards affective imagery.

Questions have been raised regarding the confounding content of the images provided by the IAPS.

Chapter 6 Let's Rewind & Begin at the Beginning: What is Neutral?

6.1 Abstract

Image content has a significant effect on electrocortical response (e.g. Kujawa, Klein, & Hajcak, 2012; Nasr & Esteky, 2009; Schindler, Zell, Botsch, & Kissler, 2017; Weinberg & Hajcak, 2010). The International Affective Picturing System's (IAPS) (Lang et al., 1997, 2008) images have been shown to have a multitude of confounds and issues (e.g. content, context, image quality and quantity available per category (Eismann, Duggan, & Grey, 2011; Sahlin, 2011)). Previous research (Ch 3, 4 and 5) has shown significant differences in response to the images rated as neutral. This research aimed to investigate the neutrality of currently accepted IAPS neutral stimuli and the impact of its apparent highly confounded nature. Participants (n = 87) completed a demographic questionnaire prior to passively viewing images over 1000ms from the five categories (IAPS Neutral, Landscapes, Dessert, Water & Clouds). Results indicated that there were significant between-sex and within-sex differences in grand mean ERP amplitude in response to the image categories that showed differences in processing between image categories. Furthermore, it was shown that Clouds and Water images evoked minimal ERP response in comparison to other groups. In conclusion, there is a requirement for the development of a current and valid collection of neutral stimuli for use in research. Implications and additional future research have been outlined.

6.2 Introduction

Lang et al., (1997; 2008) pioneered the standardisation of stimuli that has been adopted across psychological science. A catalogue of still, colour images were developed to provide a collection of affective, internationally-accessible and wide ranging stimuli for use in research (Lang et al., 2008). The images, provided by the International Affective Picturing System (IAPS), are a normative selection of emotional images (e.g. erotic, violent, neutral and disgust) that have been rated based on valance and arousal across the dimensions: pleasure, arousal and dominance (Lang et al., 2008).

The adoption of the IAPS images facilitated additional experimental control, simplified cross comparisons of results and enhanced the luxury of experimental replication (Lang et al., 1997, 2008). During their use, there has been a reliance on the normative ratings and scales for researchers to identify and select images that most closely represented the category required. However, it has been shown that the reliance on the assumption that this was adequate may not be an appropriate one (Murphy, Hill, Ramponi, Calder, & Barnard, 2010). Those pictures deemed neutral would empirically score close to the median (within a ±.05 range around the 5.0 midpoint of the IAPS scale) on the 9-point scale for arousal and valence. Thus, demonstrating that participants had rated the images as indifferent, neither emotionally positive nor negative, and had perceived them as minimally arousing (Lang et al., 2008). However, recent research has shown that there has been a confusion between ratings of arousal and valance, and ambivalence (Schneider, Veenstra, van Harreveld, Schwarz, & Koole, 2016) with calls for closer scrutiny regarding the use and reliance on the potentially ambiguous rating scales (Mikels et al., 2005; Schneider et al., 2016).

Image neutrality could be thought of as depictions of calmness, or nothingness, and with no particular effect or feature (McClelland & Eisman, 1999). It has been stated that something can be understood as neutral when it does not cause, or reflect, a change in something else (Kariger & Fierro, 2018). In the context of this research and simply by definition, it would be expected that presented neutral stimuli would aim to hold neurological activation at a homeostatic equilibrium or balance and thus have a relatively minimal effect on ERP activation. An initial electrocortical response would be anticipated toward any stimuli, including neutral, that would reflect automatic visual processing (recognition and threat detection) then little more. Importantly, it would be expected that there would be minimal differences in response to presented neutral stimuli as otherwise it would suggest that there were fundamental differences in the processing of all types of stimuli that have been overlooked in the research and literature. Leading to question the findings of any research that has used visually presented stimuli as provided by the IAPS (Lang et al, 1997).

It has been identified and evidenced across the experimental chapters of this thesis that there has been a plethora of significant differences in ERP amplitude recorded directly in response toward the IAPS neutral category of stimuli. This not only has highlighted and raised concerns regarding the effectiveness of this category and classification, it has questioned the use of these stimuli as a baseline measure due to the potential confounding content and context (Codispoti et al., 2007; Coyne et al., 2008; Cuthbert et al., 2000; Keil et al., 2002; Kemp et al., 2004). It has traditionally been accepted that emotive and affective stimuli produce increased ERP amplitude and response as measured by the blood oxygen level (BOLD) in comparison to that evoked by visually presented neutral stimuli (Aldhafeeri, Mackenzie, Kay, Alghamdi, & Sluming, 2012; Anokhin et al., 2006; Kunaharan & Walla, 2015; Lithari et al., 2010; Schupp et al., 2000; Schupp et al., 2003; Schupp, Junghofer, et al., 2004). However, differences based on IV's such as sex, trait aggression, previous lifestyle choices and experiences have suggested that there may be fundamental differences in processing that have been evoked by the confounded nature of the IAPS neutral category (see Ch 3, 4 and 5).

Research has shown that neurological activation is sensitive to stimuli content such as faces (Kato & Takeda, 2017; Kujawa et al., 2012; Nasr & Esteky, 2009; Schindler, Zell, Botsch, & Kissler, 2017), figures (Fletcher-Watson et al., 2008; Weinberg & Hajcak, 2010), animals (Leutgeb et al., 2009; Schienle et al., 2008; Schienle et al., 2005), colour (Cano et al., 2009; Zhang & Lee, 2012), and response can be impeded by elements such as content novelty (Deouell & Knight, 2005; Ferrari et al., 2010) where the fronto-central N200 component was suggested to reflect the perceived novelty of the image content and the centro-parietal P300 component showed attenuation towards image significance and meaning (Ferrari et al., 2010). However, neutral images continue to be routinely used across many fields of research using stimuli with an amalgamation of these confounding elements without any knowledge of the effects they may have produced (e.g. skewed data and potentially spurious findings and interpretation).

The IAPS image catalogue has many differing defining elements that have been included in the low arousal and valence rated neutral stimuli. The presentation of each image has simultaneously introduced a multitude of hidden confounds. For example, some images have depictions of calming scenery and tranquil landscapes; a park bench placed next to trees or a male stood riverside, fishing. However, some have faces and figures present (captured from a variety of angles) and others (i.e. park bench) appeared out of context and without either faces or figures (see Ch 6.4.3 for examples of images). In addition, the presence of water in the fishing scene could modify response based on whether participants have a positive or negative association with water (i.e. those who cannot swim may respond differently to those who can). Thus, two very simple types of scenes that have been rated as overall low arousal and valance, have very little content consistency and may evoke differences in automatic neurological response based on individual differences such as subjective experience or emotion (Ding et al., 2017; Filkowski et al., 2017).

Images of faces are homogenous with a relatively small combination of features that are organised within a prototypical arrangement in comparison to scenes (Harel, Groen, Kravitz, Deouell, & Baker, 2016) and functional magnetic resonance imaging (fMRI) studies have shown a system of neurological regions (e.g. the parahippocampal area (PPA) and the retrosplenial cortex/posterior cingulate/medial parietal region, close to the location where the calcarine sulcus joins the parietal-occipital sulcu (RSC)) that evoke increased activation during the processing of scenes in comparison to alternative content such as faces and objects (Aldhafeeri et al., 2012; Epstein, 2008). This likely reflects the content differences between images (Harel et al., 2016). Despite the abundance of EEG research addressing differences in response towards divergent content, there has been no known research that has investigated the effects of confounded neutral images relative to alternative neutral images whilst accommodating for any effects of sex.

Figures of the opposite sex have been shown to attract attention and focus (Rupp & Wallen, 2007, 2008). Thus, the addition of the predominant male figures in the IAPS neutral stimuli could for example, skew the response and produce sex differences in a heterosexual sample (see Chapter 3, 4 and 5) (Lithari et al., 2010). Other images provided by the IAPS have shown juvenile animals that could be considered as “cute and fluffy” for some participants but, potentially fear evoking (e.g. phobic) for others (Carretie et al., 2011; Schienle et al., 2008; Schienle et al., 2005). There has been no known EEG research that has investigated the effect of non-human “cute faces” (i.e. fluffy, cute animals) verses human faces on ERP amplitude therefore, it cannot be speculated as to the what the true effect the addition of animal faces may have. Although, it has been found that processing towards primate and non-primate faces showed similar magnitude (Kiani, Esteky, & Tanaka, 2005) with the processing of primate faces being recorded earlier than those of non-primate faces (e.g. Kiani, Esteky & Tanaka, 2005). Similarly, it has been shown that human faces, especially those that depict emotions, gain prioritised processing (e.g. Sato et al.,2001), real faces capture and sustain attention in comparison to artificial faces (Wheatley, Weinberg, Looser, Moran, & Hajcak, 2011) and minor perceived mismatch of facial and/or bodily features and posture within stimuli compound processing of images (Civile & Obhi, 2015; Mondloch, Nelson, & Horner, 2013).

Faces have been shown to increase the ERP activation over the 100ms, 200ms and LPP epochs (Feuerriegel, Churches, Hofmann, & Keage, 2015; Feuerriegel, Churches, & Keage, 2015; Joyce & Rossion, 2005; Schindler et al., 2017). Rousselet, Macé, and Fabre-Thorpe (2003) however, found no significant differences in response times or accuracy on a go-no-go task when comparing the rapid categorization of human faces and animals (body & face) or animal faces in the context of upright and inverted natural scenes. Thus, this has suggested that recognition and response towards animal faces are similar to those for human faces, although the exact speed of face processing has remained debatable (e.g. Kiani, Esteky & Tanaka, 2005). Rapid categorisation has been reported from 50-250ms post stimuli presentation (Itier, 2004; Meaux, Hernandez, et al., 2014; Rousselet et al., 2003; Towler & Eimer, 2015) accordingly, these have suggested that the effects of faces and potentially animal faces in neutral images could modify amplitude across a range of epochs.

Parallel to the above noted content and context issues (i.e. what effects objects found within the image, and the perceived context, could have), there appears to be several images within the IAPS inventory where the content is outdated. Irrespective in the first instance of participant age, findings in response to these images could unjustly lead researchers to ambiguous findings. For example, Bridger et al., (2017) supported research that had demonstrated frontal negativity over the 300-500ms timeframe (namely the FN400) for recollection and familiarity memory and Tsivilis et al. (2015) concluded that remote and recent memories were functionally and anatomically distinct. Thus, this has suggested that memory and age both have an impact on evoked ERP amplitude. Therefore, for example, an image of an early to mid-20th century stove top clothes iron placed on a hardwood sideboard may evoke memories or associations with childhood for an older participant whereas it could quite easily be viewed as something of questionable relevance or even, not understood for younger participants. Considering that neutral images are typically expected to be used as a baseline (e.g. in comparison to alternative content or values deducted for peak/wave difference analysis), the introduction of the vast variety of both context and content confounds requires systematic and in depth understanding to allow for any effect accommodation. One of aims of this research was to understand whether there were differences in ERP activation between the IAPS neutral images and an alternative set of images that had a maximal amount of confounds (i.e. faces, figures, animals, out of context objects etc) removed without distorting the realty of the image. In particular, the alternative images were to ensure that the content was relevant and real-life to avoid the addition of potential confounds based on abstract content (Boucher et al., 2016; Kuipers, Jones, & Thierry, 2018). Therefore, abstract words or pictures, animals, faces, figures and colour swatches were not included.

Thus far, the primary focus has been to highlight both image content and context issues however, one major aspect of using still images requires a multidisciplinary approach to consider the quality of image construction and a rudimentary understanding of the art of photography. Unfortunately, the IAPS images have ignored many of the very basic rules of photography, for example, the rule of thirds (Long, Hoang, Yuzhen, & Feng, 2011). This has been viewed as the most important aspect to photography composition. This concept is where the photographer imagines that the image has been divided up into nine equal segments using two horizontal and two vertical lines. Any element of interest should lie on a third line or at a point where any two lines intersect. This composition rule ensures that the image, and content, are balanced (Davis, 2011; Long et al., 2011; Sahlin, 2011). It has been shown that by adhering to this rule the quality of the photograph is considered high (Long et al., 2011). There has been no known EEG research that has considered the effects of using images that have adhered to basic rules in comparison to those who have not.

However, it appears reasonable, based on previous findings (e.g. Ferrari, Bradley, Codispoti, & Lang, 2010; Itier, 2004; Kujawa, Klein, & Hajcak, 2012; Leutgeb, Scha¨fer, & Schienle, 2009; Meaux et al., 2014; Nasr & Esteky, 2009; Rousselet et al., 2003; Schindler, Zell, Botsch, & Kissler, 2017; Towler & Eimer, 2015; Weinberg & Hajcak, 2010; Zhang & Lee, 2012) to speculate that processing differences may be evoked between the two image types. Regrettably, the rule of thirds is not the only photography concept that has been overlooked in the construction of the IAPS inventory. Images have an assortment of concerning elements regarding resolution, light exposure (Min, Jung, Kim, & Park, 2013; Park et al., 2013), magnification extremes, inconsistency in colour (hue, saturation and degradation), unequal and inadequate image sizing that requires additional magnification for use (and associated further quality degradation), and multiple (or sometimes none) focal points (Eismann et al., 2011; Sahlin, 2011). The IAPS images have failed to accommodate for minor, yet key, concepts that all have an impact on image quality (this is not confined to the neutral images) and potentially alter processing. These many factors could help explain some of the differences found in response to the IAPS neutral category in previous thesis chapters.

Many factors have been shown to have a modifying effect on response towards stimuli (e.g. participant IQ (Gerě & Jaušcvec, 1999; Thatcher, Palmero-Soler, North, & Biver, 2016), participant age (Bridger et al., 2017; Kensinger & Leclerc, 2009; Smith, Hillman, & Duley, 2005), emotion (Ding et al., 2017) and it is fully acknowledged and appreciated that all these factors could not be accounted for within a free to use collection of stimuli. However, in order to raise the standard of psychological research replicability, it was considered paramount that research have a standardised and current collection of stimuli that has been adequately produced with basic rules of photography considered and sufficient in number to provide a satisfactory stimuli sample per category and subcategory and most importantly, has category specific content that is valid. Therefore, initial consideration was to use four alternative subcategories of neutral (Landscapes, deserts, water and clouds see Figure 216 – 219 for examples) that were comparative with image content (see Figure 212 – 215 for examples) provided in some of the IAPS scenes whilst taking into account participant sex.

6.3 Key Aims & Hypothesis

Investigate the differences in ERP activation towards neutral images from the IAPS and a selection of alternative images extracted from royalty free internet sources that have had their content addressed (and potentially modified) to remove the maximal amount of confounds.

Hypothesis 1. There will be significant differences in ERP response between the image categories (Neutral, Landscape, Desert, Clouds, Water) across epochs.

Hypothesis 2: There will be sex differences in response towards all image categories.

Hypothesis 3. There will be significant within-sex differences in response between image categories

Hypothesis 4. There will be greater activation in response to the IAPS Neutral category in comparison to the other four categories (Landscapes; Deserts; Clouds & Water).

6.4 Methodology

6.4.1 Participants

An opportunity-based sample of 87 (Male N= 41; female N= 46) participants were recruited to take part in the research. There were a broad age range (females mean= 22.57, SD= 5.86, range 24, minimum= 18, maximum= 42; males mean= 21.2, SD= 4.68, range 19, minimum=

18, maximum= 37). The sample were not paid for their participation, however, first and second year psychology students were awarded research credits for participating. All of the participants had normal or corrected to normal vision, 20/20 (UK). Participants with a history of mental health illness and those currently taking un/prescribed medication were excluded from the study.

6.4.2 Apparatus and Materials

The apparatus used was as outlined in the methodology chapter (see ch 2.).

6.4.3 Stimuli Presented

Images taken from the IAPS (Lang et al., 1997, 2008) neutral category and 120 additional royalty free images (categorized as Landscape; Water; Clouds; Deserts) were used (see Ch 2.2.17). All images were the same size (19cm x 19cm). This ensured that the screen positioning was consistent across all experiments.

Due to the terms of use, actual images from the IAPS (Lang, Bradley, & Cuthbert, 1997; 2008) cannot be provided here however, neutral images from the IAPS have included for example: scenes of landscapes, relaxing activities, objects and animals. Similar images to those provided by the IAPS have been selected from the internet for illustration purposes (see and have been provided for illustration purposes Figures 212 – 215). These are not to actual size or scale.

Figure 222. Scenes of landscape tranquillity.

Figure 223. Scenes of relaxing activities.

Figure 224. Inanimate colourful objects

Figure 225. Animals

The following four images (see Figures 216 – 219) have been selected to demonstrate the content of the image categories used for the additional 120 images. There were 30 of each category: clouds, desert, water and landscapes. Any image anomalies or objects that could attract attention or gaze (e.g. sheep, pylons, green desert grasses, trees etc) were removed with the use of image modification software (Adobe Photoshop C6) on an external windows operating system.


Figure 226. Clouds


Figure 227. Deserts

Figure 228. Landscapes

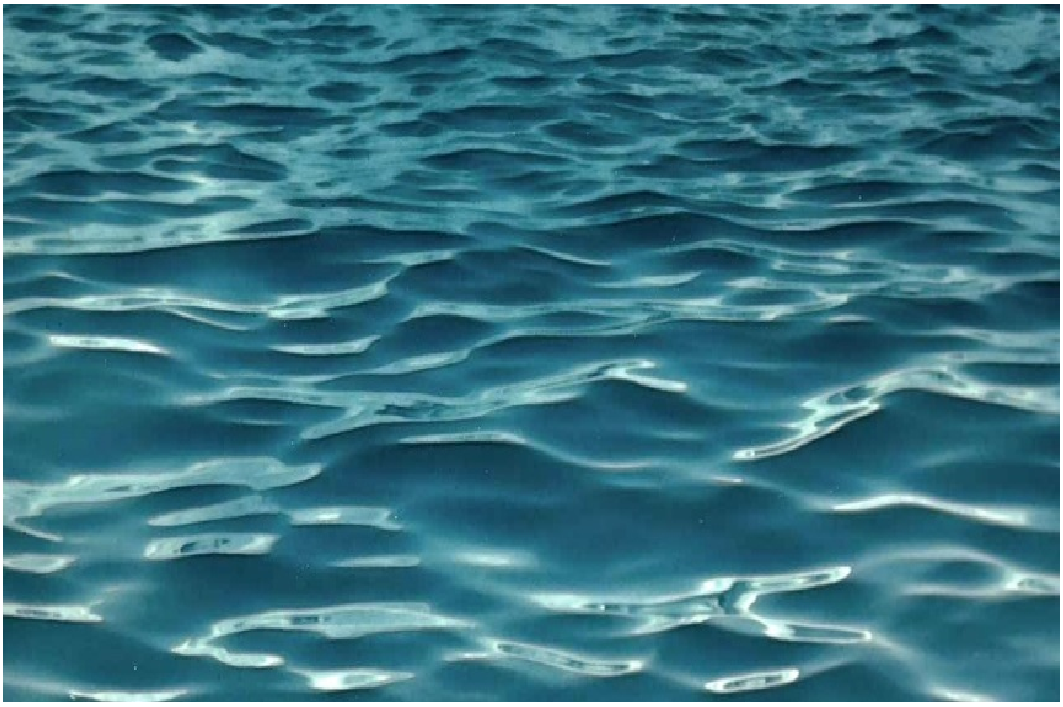


Figure 229. Water

6.4.4 Design

This research was quasi-experimental in design. All variables (except from image) were based on group differences (not random allocation). The research used both repeated and independent measures. The research was a mixed method design; there were both repeated and independent measures. The repeated measures component was the five groups of images (IAPS Neutral, Landscape, Clouds, Deserts and Water). Although, the variables were not directly manipulated, they have been referred to as independent variables throughout. The Independent variables (IV) were sex (2 levels, males and females) and images (5 levels, neutral (IAPS), clouds, water, landscapes and desserts). The dependent variable was the grand mean average ERP (measured in microvolt's, uV) scores, measured by the EEG in response to the images presented.

6.4.5 Procedure

The procedure was as outlined in Chapter 2.

6.4.6 Data Analysis

The data was processed and analysed as outlined in Chapter 2.

6.5 Results

EEG amplitudes were recorded and standard descriptive statistics are summarised in the below sequence of tables (Table 104 – 108). Results have been subdivided into sections for clarity (Ch 6.5.1 Between Sex and Image Analysis; Ch 6.5.2 Within Sex Analysis). Prior to performing the statistical analysis, a test of normality is generally undertaken, however due to sample size (n= 87; females=46; males=41), assumptions of normality were waivered in line with the Central Limit Theorem that states given random and independent samples of N observations, the distribution of sample means will approach normality as the size of N increases, regardless of the shape of the population distribution (Field, 2013; Fischer, 2011).

The data was segmented into epochs (100, 200, 300 and ELPP and LLPP) as outlined in Chapter 2.2.7 Epochs. Four cortical measurement sites were selected; the frontal region (Fz), frontal central (Fcz), central (Cz) and parietal (Pz). Where variables violated the assumptions of sphericity, the results provided show corrected values using the Greenhouse-Geisser correction. Alpha was set at 0.05. However, where required, all p-values were adjusted for multiple comparisons using Bonferroni technique.

6.5.1 Between Sex and Image Analysis

6.5.1.1 50 – 150ms Post Stimuli (100ms)

Table 104. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 100ms timeframe.

100ms	Male (n=41)		Female (n=46)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-0.26	2.00	-1.39	1.97
Clouds	-0.24	1.76	-0.62	1.93
Water	0.36	1.85	-0.57	1.50
Deserts	-0.52	1.43	-0.58	1.58
Landscapes	-0.53	1.64	-1.28	1.51
Fcz				
Neutral	-0.79	1.50	-1.61	1.74
Clouds	-0.73	1.68	-1.13	1.59
Water	-0.01	1.67	-1.07	1.25
Deserts	-0.92	1.40	-1.00	1.16
Landscapes	-0.74	1.63	-1.53	1.31
Cz				
Neutral	-1.85	1.31	-0.74	1.21
Clouds	-1.75	1.63	-0.84	1.12
Water	-1.21	1.07	-0.80	1.01
Deserts	-1.29	1.52	-1.13	1.21
Landscapes	-1.30	1.42	-0.78	1.16
Pz				

Neutral	-0.79	2.41	0.78	1.90
Clouds	-0.53	1.35	0.90	1.54
Water	-0.43	1.52	0.67	1.43
Deserts	-0.20	1.65	0.46	1.84
Landscapes	-0.69	1.81	0.82	1.88

6.5.1.2 150 – 250ms Post Stimuli (200ms)

Table 105. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 200ms timeframe.

200ms	Male (n=41)		Female (n=46)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-2.04	3.24	-3.66	3.52
Clouds	-0.64	2.99	-1.74	3.02
Water	0.18	2.62	-1.36	2.31
Deserts	-1.93	2.51	-2.88	2.57
Landscapes	-2.29	2.73	-3.48	2.29
Fcz				
Neutral	-2.46	2.84	-3.42	3.02
Clouds	-0.79	2.67	-1.62	2.61
Water	-0.11	2.57	-1.17	1.86
Deserts	-2.08	2.54	-2.75	2.05
Landscapes	-2.26	2.65	-3.26	2.01
Cz				
Neutral	-2.01	3.08	-0.07	2.03
Clouds	-0.56	2.04	0.93	1.71
Water	0.12	2.53	0.94	1.42
Deserts	-1.20	2.52	-0.09	1.87
Landscapes	-1.37	2.56	-0.04	1.48

Pz				
Neutral	0.96	2.66	3.50	3.31
Clouds	1.58	1.92	3.34	2.24
Water	1.82	2.09	3.04	1.98
Deserts	2.00	1.99	3.32	2.87
Landscapes	1.39	2.29	3.45	2.77

6.5.1.3 250 – 450ms Post Stimuli (300ms)

Table 106. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females across Fz, Fcz, Cz and Pz, measurement sites for each image category for the 300ms timeframe.

300ms	Male (n=41)		Female (n=46)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-1.64	2.98	-2.33	3.56
Clouds	-1.61	3.64	-1.53	3.37
Water	-1.97	3.12	-2.40	2.32
Deserts	-3.94	3.47	-2.98	2.75
Landscapes	-3.50	2.60	-3.12	2.53
Fcz				
Neutral	-2.45	2.71	-2.90	2.95
Clouds	-1.93	3.46	-1.96	2.62
Water	-2.17	2.95	-2.49	1.94
Deserts	-4.06	3.22	-3.21	2.32
Landscapes	-3.63	2.49	-3.48	2.17
Cz				
Neutral	-2.46	3.16	-1.47	1.98
Clouds	-2.13	2.62	-0.27	1.93
Water	-1.49	2.42	-0.54	1.74
Deserts	-2.40	2.27	-1.11	1.69
Landscapes	-2.71	2.18	-1.33	1.60

Pz				
Neutral	0.76	2.77	2.22	2.60
Clouds	1.14	2.13	3.00	2.25
Water	2.01	3.05	2.73	2.02
Deserts	2.27	1.92	2.81	2.55
Landscapes	1.50	2.67	2.75	2.80

6.5.1.4 450 – 650ms Post Stimuli (ELPP)

Table 107. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females across Fz, Fcz, Cz and Pz, measurement sites for each image category for the ELPP timeframe.

ELPP	Male (n=41)		Female (n=46)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-0.86	2.98	-1.23	3.43
Clouds	-0.60	3.23	-0.38	3.45
Water	-1.02	3.18	-1.03	2.20
Deserts	-2.34	2.74	-1.11	2.64
Landscapes	-1.91	2.36	-0.85	2.36
Fcz				
Neutral	-1.58	2.70	-1.72	2.80
Clouds	-1.05	3.00	-0.91	2.71
Water	-1.26	3.02	-1.22	1.92
Deserts	-2.60	2.51	-1.55	2.15
Landscapes	-2.19	2.25	-1.42	2.01
Cz				
Neutral	-0.96	2.70	-0.39	1.58
Clouds	-1.37	1.85	0.11	1.97
Water	-0.99	2.69	-0.02	1.58
Deserts	-1.58	1.60	-0.45	1.49

Landscapes	-1.56	1.57	-0.75	1.50
Pz				
Neutral	1.47	2.68	1.99	2.22
Clouds	0.25	1.81	2.19	2.40
Water	0.61	2.56	1.92	2.00
Deserts	1.36	1.18	2.04	2.06
Landscapes	1.12	2.64	1.61	2.16

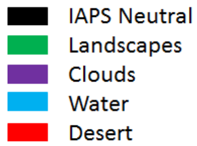
6.5.1.5 650 – 850ms Post Stimuli (LLPP)

Table 108. Means and standard deviations of EEG amplitudes, measured in microvolt's (uV), for males and females across Fz, Fcz, Cz and Pz, measurement sites for each image category for the LLPP timeframe.

LLPP	Male (n=41)		Female (n=46)	
Region and Image Category	Mean	SD	Mean	SD
Fz				
Neutral	-0.24	3.21	-0.56	2.77
Clouds	0.17	2.39	0.37	3.18
Water	-0.20	2.91	0.29	2.51
Deserts	-1.00	2.53	0.25	2.35
Landscapes	-0.32	2.08	0.31	2.20
Fcz				
Neutral	-0.70	2.76	-0.83	2.33
Clouds	-0.05	2.25	-0.14	2.55
Water	-0.34	2.51	-0.02	1.99
Deserts	-1.32	2.38	-0.27	1.87
Landscapes	-0.52	1.89	-0.34	2.02
Cz				
Neutral	-0.12	2.07	0.03	1.27
Clouds	-0.70	1.43	0.16	1.60
Water	-0.16	2.14	0.14	1.10
Deserts	-0.95	1.62	-0.42	1.29

Landscapes	-0.79	1.10	-0.70	1.59
Pz				
Neutral	1.15	2.54	1.39	1.57
Clouds	-0.20	1.30	1.13	2.14
Water	0.46	1.97	0.98	1.60
Deserts	0.41	1.50	0.80	1.57
Landscapes	-0.22	1.94	0.43	2.23

Below, ERP waveforms show grand mean responses for males and females towards the neutral categories for each measurement site across recording time (1000ms) (see Figures 220 – 227).



Males

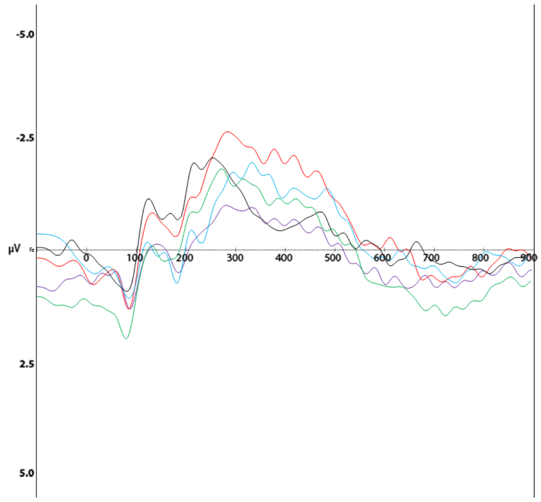


Figure 230. Grand average ERP waveform (microvolts) for males at the Fz location, across time (milliseconds).

Females

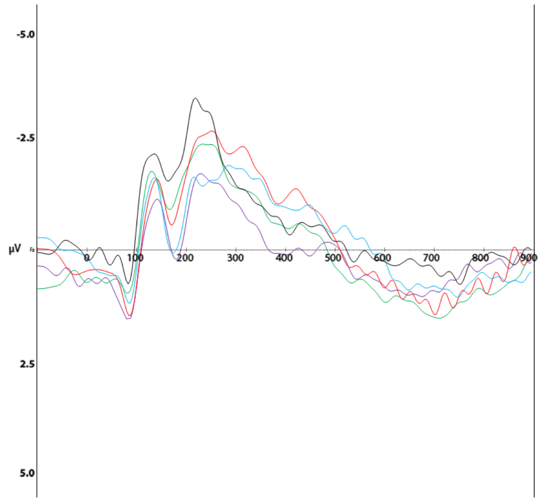


Figure 231. Grand average ERP waveform (microvolts) for females at the Fz location, across time (milliseconds).

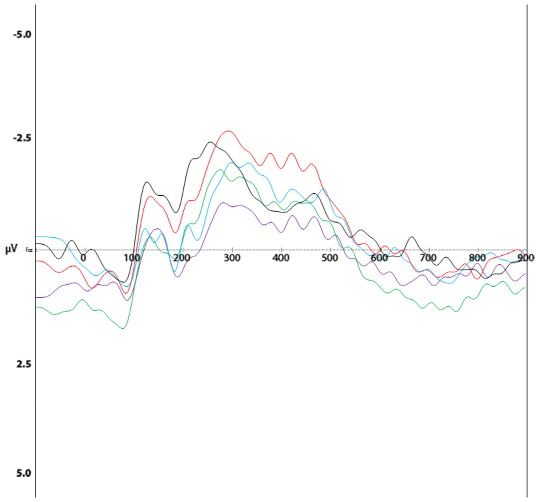


Figure 232. Grand average ERP waveform (microvolts) for males at the Fcz location, across time (milliseconds).

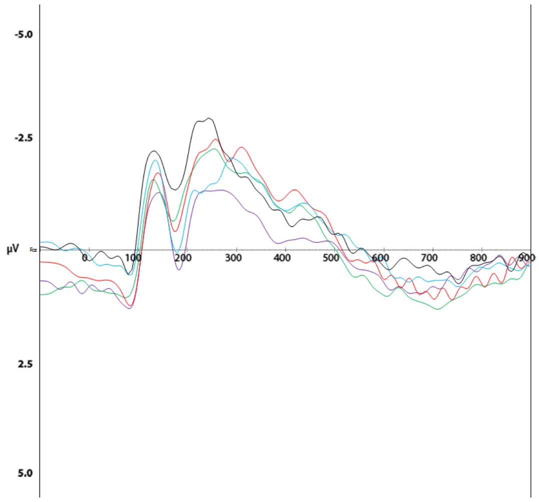


Figure 233. Grand average ERP waveform (microvolts) for females at the Fcz location, across time (milliseconds).

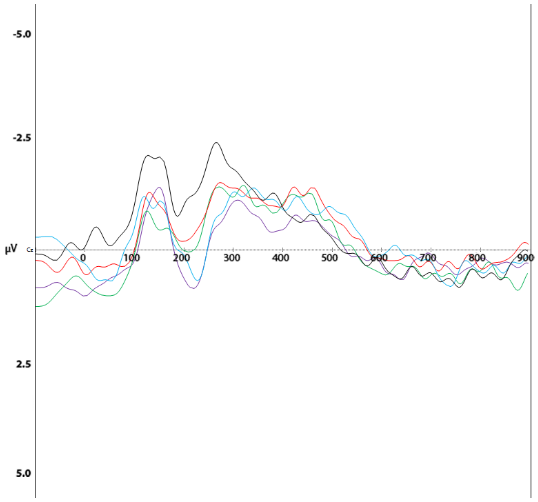


Figure 234. Grand average ERP waveform (microvolts) for males at the Cz location, across time (milliseconds).

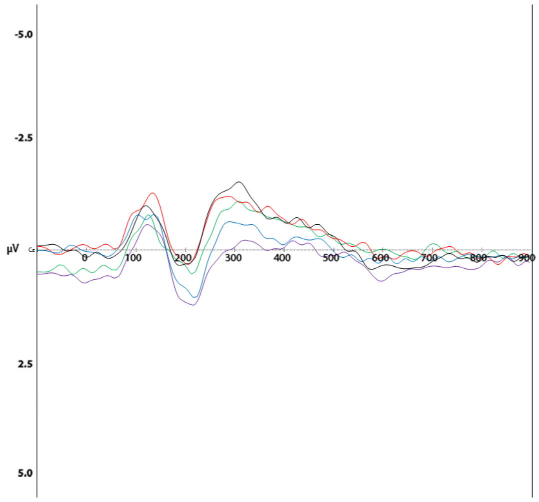
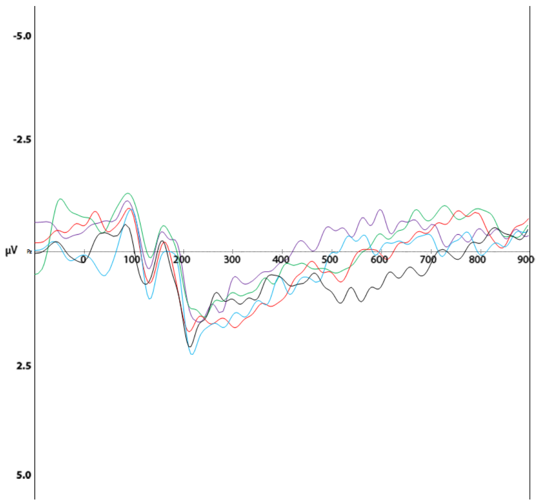


Figure 235. Grand average ERP waveform (microvolts) for females at the Cz location, across time (milliseconds).



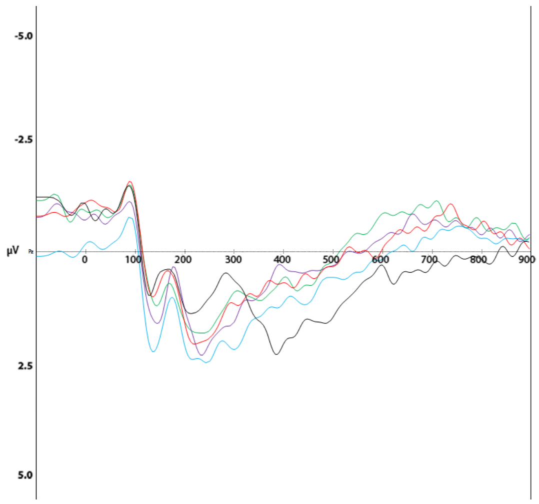


Figure 236. Grand average ERP waveform (microvolts) for males at the Pz location, across time (milliseconds).

Figure 237. Grand average ERP waveform (microvolts) for females at the Pz location, across time (milliseconds).

The overall analysis of grand mean amplitudes generated significant main effects of sex and image (Table 109.). Table 110 shows the significant p-values for the main effect of sex (for comprehensive results see Appendix AD.) and Table 111. demonstrates significant P-values for the main effects for image. The effect of sex was evident over early frontal sites (Fz and Fcz) and was prominent over the central (Cz) and parietal (Pz) measurement clusters. Independent groups t-tests revealed that females tended to respond with an increased negativity over frontal sites and with increased positivity over central and parietal sites in comparison to males (Tables 104 – 110). There were significant sex differences found in response to all image categories. Thus, demonstrating processing differences based on sex.

Whereas the main effects of image were found predominantly across frontal and central sites with only two effects found across the Pz site (300ms and LLPP). Pairwise comparisons showed that differences were found between all image groups over frontal and central sites (Table 111.) but only between the IAPS Neutral and Deserts; Clouds and Landscapes over the parietal electrodes. Thus, demonstrating processing differences based on image category.

There were significant sex by image interactions over the Fz, Fcz and Cz measurement sites (Table 109) thus demonstrating that the effect of image was not consistent across sex. Due to these findings, it was considered appropriate to conduct a within sex analysis.

Table 109. Bonferroni corrected p-values of the ANOVA showing significant main and interaction effects across electrode and epoch on grand mean ERP amplitudes in response towards the five image categories.

Site	Epoch	Effect		
		Sex	Image	Interaction
Fz	100ms	$F(1, 85) = 5.63$, $p=0.02$, $\eta p2=.07$	$F(4, 85) = 5.24$, $p=0.02$, $\eta p2=.06$	$F(4, 85) = 2.37$, $p=0.05$, $\eta p2=.02$
	200ms	$F(1, 85) = 5.99$, $p=0.02$, $\eta p2=.07$	$F(3.12, 85) = 38.24$, $p<0.01$, $\eta p2=.31$	
	300ms		$F(3.49, 85) = 18.86$, $p<0.01$, $\eta p2=.18$	$F(4, 85) = 2.93$, $p=0.02$, $\eta p2=.03$
	ELPP		$F(3.66, 85) = 4.85$, $p<0.01$, $\eta p2=.05$	$F(3.66, 85) = 2.75$, $p=0.03$, $\eta p2=.03$
	LLPP			
Fcz	100ms	$F(1, 85) = 6.60$, $p=0.01$, $\eta p2=.08$	$F(4, 85) = 4.88$, $p<0.01$, $\eta p2=.05$	$F(4, 85) = 2.72$, $p=0.03$, $\eta p2=.03$
	200ms	$F(1, 85) = 3.75$, $p=0.05$, $\eta p2=.06$	$F(3.51, 85) = 47.39$, $p<0.01$, $\eta p2=.36$	
	300ms		$F(4, 85) = 21.35$, $p<0.01$, $\eta p2=.18$	$F(4, 85) = 2.48$, $p=0.04$, $\eta p2=.03$
	ELPP		$F(3.65, 85) = 6.20$, $p<0.01$, $\eta p2=.07$	
	LLPP		$F(4, 85) = 3.03$, $p=0.02$, $\eta p2=.03$	

Cz	100ms	F(1, 85)= 11.27, p<0.01, ηp2=.12		F(4, 85)= 2.85, p=0.03, ηp2=.03
	200ms	F(1, 85)= 11.09, p<0.01, ηp2=.12	F(3.48,85)= 25.93, p<0.01, ηp2=.23	F(4.40,85)= 2.63, p=0.04, ηp2=.03
	300ms	F(1, 85)= 10.84, p<0.01, ηp2=.12	F(3.44,85)= 10.15, p<0.01, ηp2=.11	
	ELPP	F(1, 85)= 11.97, p<0.01, ηp2=.13	F(3.22,85)= 2.96, p=0.03, ηp2=.13	
	LLPP	F(1, 85)= 4.42, p=0.03, ηp2=.05	F(3.26,85)= 5.00, p<0.01, ηp2=.06	
Pz	100ms	F(1, 85)= 21.44, p<0.01, ηp2=.20		
	200ms	F(1, 85)= 16.79, p<0.01, ηp2=.17		
	300ms	F(1,85)= 7.61, p<0.01, ηp2=.08	F(3.20,85)= 4.74, p<0.01, ηp2=.07	
	ELPP	F(1,85)= 10.75, p<0.01, ηp2=.12		
	LLPP	F(1,85)= 9.25, p<0.01, ηp2=.10	F(4,85)= 4.86, p<0.01, ηp2=.05	

Table 110. Significant p-values from Independent T-tests for the effect of sex, across site and epoch.

	Epoch

Region and Image Category	100	200	300	ELPP	LLPP
Fz					
Neutral	t=2.66, df=85, p=0.01, d=0.57	t=2.21, df=85, p=0.03, d=0.48			
Clouds					
Water	t=2.58, df=85, p=0.01, d=0.55	t=2.9, df=85, p<0.01, d=0.62			
Deserts					
Landscapes	t=2.22, df=85, p=0.03, d=0.48	t=2.22, df=85, p=0.03, d=0.47			
Fcz					
Neutral	t=2.34, df=85, p=0.02, d=0.50				
Clouds					
Water	t=3.36, df=85, p<0.01, d=0.72	t=2.22, df=85, p=0.03, d=0.47			
Deserts					
Landscapes	t=2.49, df=85, p=0.01, d=0.53	t=2.01, df=85, p=0.05, d=0.42			
Cz					

Neutral	t=-4.08, df=85, p<0.01, d=0.88	t=-3.51, df=85, p<0.01, d=0.74			
Clouds	t=-3.06, df=85, p<0.01, d=0.65	t=-3.7, df=85, p<0.01, d=0.79	t=-3.81, df=85, p<0.01, d=0.81	t=-3.61, df=85, p<0.01, d=0.78	t=-2.63, df=85, p=0.01, d=0.57
Water			t=-2.12, df=85, p=0.04, d=0.45	t=-2.08, df=85, p=0.04, d=0.44	
Deserts		t=-2.35, df=85, p=0.02, d=0.5	t=-3.01, df=85, p<0.01, d=0.64	t=-3.41, df=85, p<0.01, d=0.73	
Landscapes		t=-3, df=85, p<0.01, d=0.64	t=-3.4, df=85, p<0.01, d=0.72	t=-2.49, df=85, p=0.01, d=0.53	
Pz					
Neutral	t=-3.4, df=85, p<0.01, d=0.72	t=-3.9, df=85, p<0.01, d=0.85	t=-2.53, df=85, p=0.01, d=0.54		
Clouds	t=-4.57, df=85, p<0.01, d=0.99	t=-3.93, df=85, p<0.01, d=0.84	t=-3.96, df=85, p<0.01, d=0.85	t=-4.2, df=85, p<0.01, d=0.91	t=-3.46, df=85, p<0.01, d=0.75
Water	t=-3.47, df=85, p<0.01, d=0.75	t=-2.8, df=85, p=0.01, d=0.60		t=-2.7, df=85, p=0.01, d=0.57	
Deserts		t=-2.47, df=85, p=0.02, d=0.53			
Landscapes	t=-3.79, df=85, p<0.01, d=0.82	t=-3.76, df=85, p<0.01, d=0.81	t=-2.14, df=85, p=0.04, d=0.46		

Table 111. Significant P–values for pairwise comparisons across the effect of image across site and epoch.

Site	Epoch	Effect	Difference Between Groups	P-value*
		Image		
Fz	100ms	$F(4, 85)= 5.24$, $p=0.02$ $\eta p2=.06$	Neutral - Water	=0.01
			Water - Landscape	<0.01
	200ms	$F(3.12, 85)= 38.24$, $p<0.01$ $\eta p2=.31$	Neutral - Cloud	<0.01
			Neutral - Water	<0.01
			Cloud – Deserts	<0.01
			Cloud - Landscape	<0.01
			Desert - Water	<0.01
			Landscape - Water	<0.01
	300ms	$F(3.49, 85)= 18.86$, $p<0.01$ $\eta p2=.18$	Neutral - Desert	<0.01
			Neutral - Landscape	<0.01
			Cloud – Desert	<0.01
			Cloud – Landscape	<0.01
			Water – Desert	<0.01
			Water – Landscape	<0.01
	ELPP	$F(3.66, 85)= 4.85$, $p<0.01$ $\eta p2=.05$	Cloud – Desert	<0.01
	LLPP			

Fcz	100ms	$F(4, 85)= 4.88$, $p<0.01$ $\eta p2=.05$	Neutral – Water	<0.01
			Water – Landscape	<0.01
	200ms	$F(3.51, 85)= 47.39$, $p<0.01$ $\eta p2=.36$	Neutral - Cloud	<0.01
			Neutral – Water	<0.01
			Cloud – Deserts	<0.01
			Cloud – Landscape	<0.01
			Desert – Water	<0.01
			Landscape – Water	<0.01
	300ms	$F(4, 85)= 21.35$, $p<0.01$ $\eta p2=.18$	Neutral – Desert	<0.01
			Neutral – Landscape	<0.01
			Cloud – Desert	<0.01
			Cloud – Landscape	<0.01
			Water – Desert	<0.01
			Water – Landscape	<0.01
	ELPP	$F(3.65, 85)= 6.20$, $p<0.01$ $\eta p2=.07$	Neutral – Cloud	<0.01
			Cloud – Desert	<0.01
	LLPP	$F(4, 85)= 3.03$, $p=0.02$ $\eta p2=.03$	Cloud – Desert	=0.03
Cz	200ms	$F(3.48,85)= 25.93$, $p<0.01$ $\eta p2=.23$	Neutral – Cloud	<0.01
			Neutral – Water	<0.01

			Cloud – Desert	<0.01
			Cloud – Landscape	<0.01
			Water – Desert	<0.01
			Water – Landscape	<0.01
	300ms	F(3.44,85)= 10.15, p<0.01 ηp2=.011	Neutral – Cloud	<0.01
			Neutral – Water	<0.01
			Cloud – Landscape	<0.01
			Water – Desert	=0.01
			Water – Landscape	<0.01
	ELPP	F(3.22,85)= 2.96, p=0.03 ηp2=.13	Water – Landscape	=0.04
	LLPP	F(3.26,85)= 5.00, p<0.01 ηp2=.06	Neutral – Landscape	=0.05
			Water – Landscape	=0.03
Pz	300ms	F(3.20,85)= 4.74, p<0.01 ηp2=.07	Neutral – Desert	<0.01
	LLPP	F(4,85)= 4.86, p<0.01 ηp2=.05	Neutral – Cloud	<0.01

*Values adjusted for multiple comparisons using Bonferroni correction

6.5.2 Within Sex Analysis

Descriptive statistics have been provided for both males and females (see Tables 91 – 95).

6.5.2.1 Males

For males, the analysis of grand mean amplitudes generated significant effects of image (Table 112.). Table 113 shows the significant p-values for these. Main effects of image were found across all sites with the majority of significant differences been shown between groups Neutral; Clouds and Water in comparison to Landscapes and Deserts. Landscapes and Desert categories were comparable in response with only one significant difference found (Pz, 300ms epoch) between them. This demonstrated that there were within sex differences in processing between the image categories across all measurement sites with the majority being found over frontal electrode clusters for males (see Table 113.). Line graphs (see Figures 238 – 245) showed that for males, both clouds and water images tended to evoke a minimal mean ERP response in comparison to other categories across all sites except from the parietal location. Over the Pz region, the IAPS Neutral category showed minimal ERP response in comparison to other groups over the 200ms and 300ms epochs however, the Clouds category were found to have minimal response for the later epochs (ELPP and LLPP). Thus, this suggested that the most appropriate category of neutral image was shown to be dependent on epoch and measurement electrode for males.

Table 112. Bonferroni corrected p-values of the ANOVA showing significant effects of image across electrode and epoch on grand mean ERP amplitudes in response towards the five image categories for both males and females

Site	Epoch	Effect of Image	
		Male	Female
Fz	100ms	$F(2.97, 40)= 2.9$, $p=0.02$, $\eta p2=.07$	$F(4, 45)= 4.9$, $p<0.01$, $\eta p2=.10$
	200ms	$F(3.17, 40)= 20.92$, $p<0.01$, $\eta p2=.34$	$F(2.91, 45)= 18.51$, $p<0.01$, $\eta p2=.29$
	300ms	$F(4, 40)= 16.67$, $p<0.01$, $\eta p2=.29$	$F(3.13, 45)= 5.35$, $p<0.01$, $\eta p2=.11$
Fcz	100ms	$F(2.93, 40)= 3.97$, $p=0.01$, $\eta p2=.09$	$F(4, 45)= 3.45$, $p=0.01$, $\eta p2=.07$
	200ms	$F(4, 40)= 21.87$, $p<0.01$, $\eta p2=.40$	$F(3.09, 45)= 25.94$, $p<0.01$, $\eta p2=.37$
	300ms	$F(4, 40)= 14.45$, $p<0.01$, $\eta p2=.60$	$F(3.23, 45)= 8.09$, $p<0.01$, $\eta p2=.15$
	ELPP	$F(4, 40)= 5.94$, $p<0.01$, $\eta p2=.13$	
	LLPP	$F(4, 40)= 2.79$, $p=0.03$, $\eta p2=.05$	
Cz	200ms	$F(4, 40)= 14.55$, $p<0.01$, $\eta p2=.27$	$F(3.26, 45)= 12.56$, $p<0.01$, $\eta p2=.22$
	300ms	$F(4, 40)= 3.92$, $p<0.01$, $\eta p2=.09$	$F(2.29, 45)= 9.14$, $p<0.01$, $\eta p2=.17$
	LLPP		$F(2.14, 45)= 4.02$, $p<0.01$, $\eta p2=.08$
Pz	200ms	$F(3.23, 40)= 2.91$, $p=0.02$, $\eta p2=.07$	
	300ms	$F(2.52, 40)= 4.98$, $p<0.01$, $\eta p2=.11$	
	LLPP	$F(2.41, 40)= 3.88$, $p=0.01$, $\eta p2=.08$	

Table 113. Significant P-values from the pairwise corrections for male participants.

Site	Epoch	Difference Between Groups	P-value*
Fz	100ms	Water – Landscapes	=0.04
	200ms	Neutral – Clouds	<0.01
		Neutral – Water	<0.01
		Clouds – Deserts	<0.01
		Clouds – Landscapes	<0.01
		Water – Deserts	<0.01
		Water – Landscapes	<0.01
	300ms	Neutral – Desert	<0.01
		Neutral – Landscape	<0.01
		Cloud – Desert	<0.01
		Cloud – Landscape	<0.01
		Water – Desert	<0.01
		Water – Landscape	<0.01
	ELPP	Neutral – Deserts	<0.01
		Neutral – Landscapes	=0.05
		Clouds – Deserts	<0.01
		Clouds – Landscapes	=0.04
Fcz	100ms	Neutral – Water	=0.03
		Water – Deserts	=0.02
	200ms	Neutral – Clouds	<0.01
		Neutral – Water	<0.01
		Clouds – Deserts	<0.01
		Clouds – Landscapes	<0.01
		Water – Deserts	<0.01
		Water – Landscapes	<0.01
	300ms	Neutral – Desert	<0.01
		Neutral – Landscape	<0.01
		Cloud – Desert	<0.01

		Cloud – Landscape	<0.01
		Water – Desert	<0.01
		Water – Landscape	<0.01
	ELPP	Neutral – Deserts	=0.05
		Clouds – Deserts	<0.01
		Water – Deserts	=0.04
	LLPP	Cloud – Desert	<0.01
Cz	200ms	Neutral – Clouds	<0.01
		Neutral – Water	<0.01
		Water – Deserts	<0.01
		Water – Landscapes	<0.01
	300ms	Water – Landscapes	<0.01
Pz	300ms	Neutral – Deserts	<0.01
		Clouds – Deserts	<0.01
		Deserts – Landscapes	=0.03
	LLPP	Neutral – Cloud	<0.01

*Values adjusted for multiple comparisons using Bonferroni correction.

6.5.2.2 Females

For female participants, the analysis of grand mean amplitudes generated significant effects of image (Table 99.). Table 101 shows the significant p-values for these. Main effects of image were found at frontal (Fz and Fcz) and central (Cz) sites with the majority of significant differences occurring between Neutral, Clouds or Water categories when compared to Landscapes and Desert categories (see Table 114). This demonstrated that there were within sex differences in processing between the image categories across sites with the majority being found over frontal electrode clusters for females (see Table 114.). Line graphs and ERP waveforms (see Figure 238 - 245) showed that like males, the female response towards both clouds and water images tended to evoke a minimal mean ERP response in comparison to other categories. Landscapes, desert and IAPS Neutral image categories demonstrated maximal mean ERP response amplitudes and found no significant differences between these groups across site or epoch (see Table 114). Thus, this suggested that the most appropriate category of neutral image was shown to be dependent on epoch and measurement electrode for females.

Table 114. Significant P-values from the pairwise corrections for female participants.

Site	Epoch	Difference Between Groups	P-value*
Fz	100ms	Neutral – Clouds	=0.04
		Neutral – Water	=0.03
	200ms	Neutral – Clouds	<0.01
		Neutral – Water	<0.01
		Clouds – Deserts	=0.01
		Clouds – Landscapes	<0.01
		Water – Deserts	<0.01
		Water – Landscapes	<0.01
	300ms	Clouds – Deserts	=0.01
		Clouds – Landscapes	<0.01
Fcz	200ms	Neutral – Clouds	<0.01
		Neutral – Water	<0.01
		Clouds – Deserts	<0.01
		Clouds – Landscapes	<0.01
		Water – Deserts	<0.01
		Water – Landscapes	<0.01
	300ms	Clouds – Deserts	<0.01
		Clouds – Landscapes	<0.01
		Water – Landscapes	<0.01
Cz	200ms	Neutral – Clouds	<0.01
		Neutral – Water	<0.01
		Clouds – Deserts	<0.01
		Clouds – Landscapes	<0.01
		Water – Deserts	<0.01
		Water – Landscapes	<0.01

	300ms	Neutral – Clouds	<0.01
		Neutral – Water	<0.01
		Clouds – Landscapes	<0.01
		Water – Landscapes	=0.03

*Values adjusted for multiple comparisons using Bonferroni correction.

6.5.3 Graphs

This analysis identifies within-sex differences in grand mean ERPs by location and epoch towards the five neutral content images (Neutral, Landscape, Dessert, Clouds, Water). Due to evidence of sex differences between each image category, within sex effects were investigated. It has been shown that across frontal and central sites Clouds and Water image categories tended to evoke minimal ERP amplitude for both males and females. This has been shown in Figures 238 to 245. However, over the parietal site there appeared very little to separate the alternative category groups for females however, the response towards the IAPS neutral category was maximal over early and late epochs and minimal for the 300ms epoch. For males, differentiation between response was found for each epoch with the IAPS neutral category demonstrating maximal mean amplitude for 100ms, ELPP and LLPP epochs and minimal for 200 and 300ms. Thus, demonstrating content / category specific differences in ERP amplitude within sex.

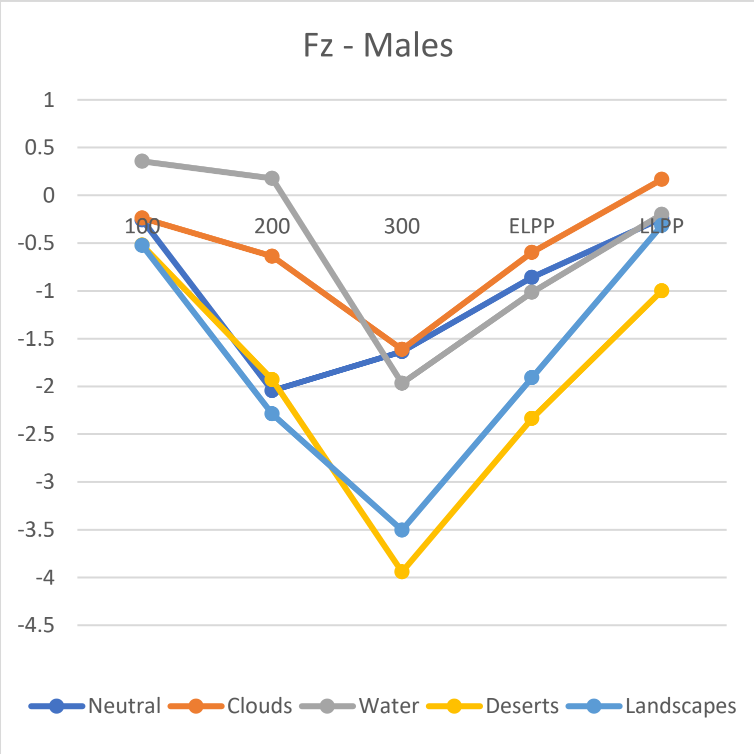


Figure 238. Mean average ERP amplitude (μV) for the male participants in response to each image category, across epochs for the Fz measurement site

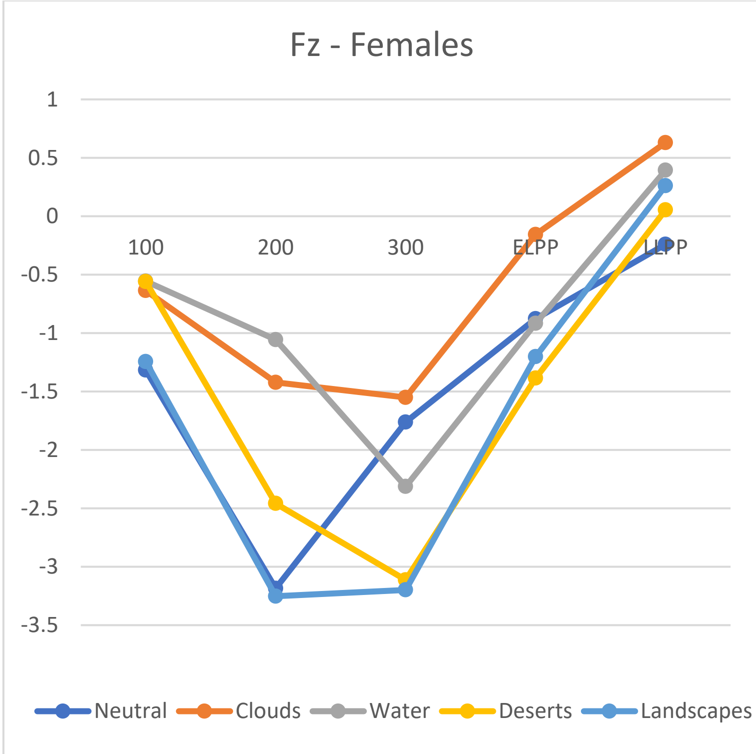


Figure 239. Mean average ERP amplitude (μV) for the female participants in response to each image category, across epochs for the Fz measurement site

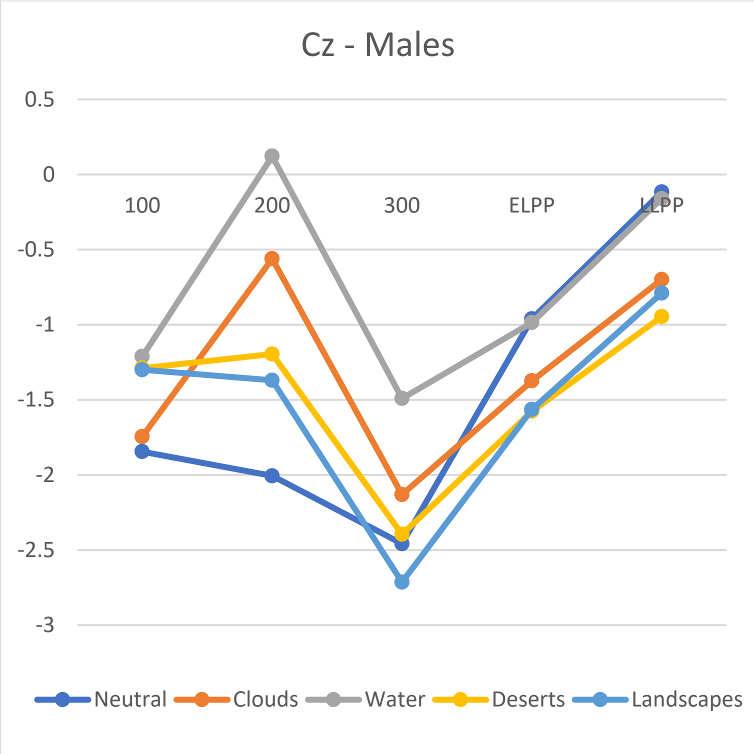


Figure 240. Mean average ERP amplitude (µV) for the male participants in response to each image category, across epochs for the Cz measurement site

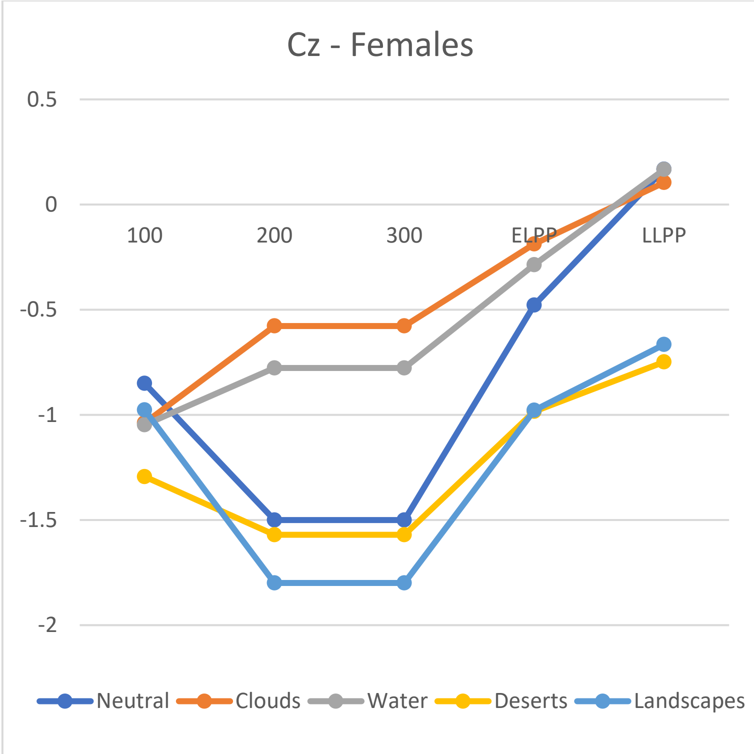


Figure 241. Mean average ERP amplitude (µV) for the female participants in response to each image category, across epochs for the Cz measurement site

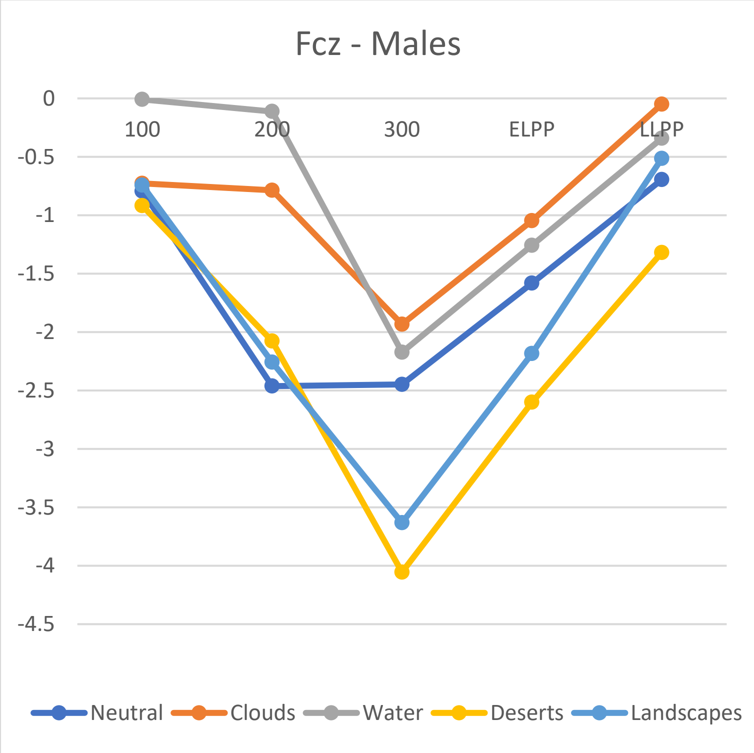


Figure 242. Mean average ERP amplitude (µV) for the male participants in response to each image category, across epochs for the Fcz measurement site

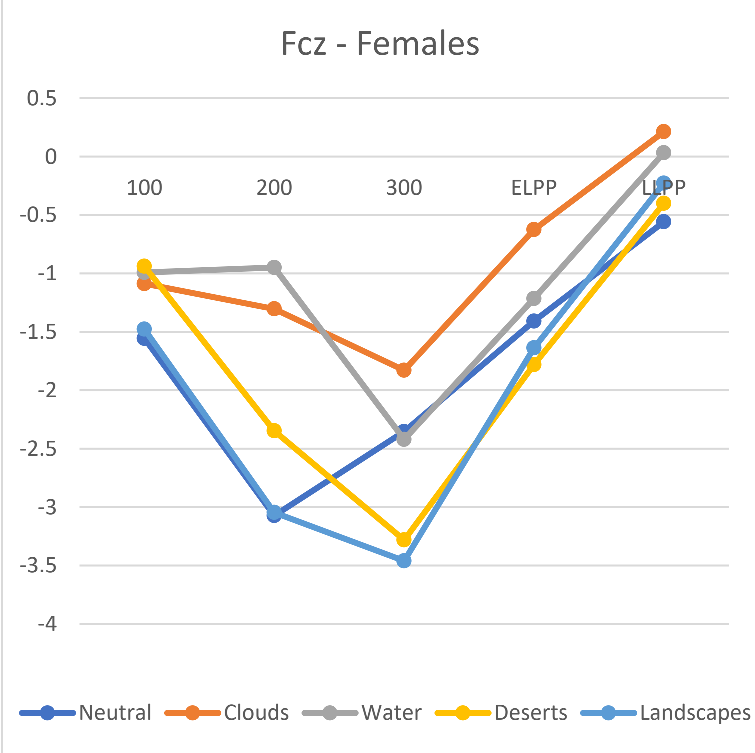


Figure 243. Mean average ERP amplitude (µV) for the female participants in response to each image category, across epochs for the Fcz measurement site

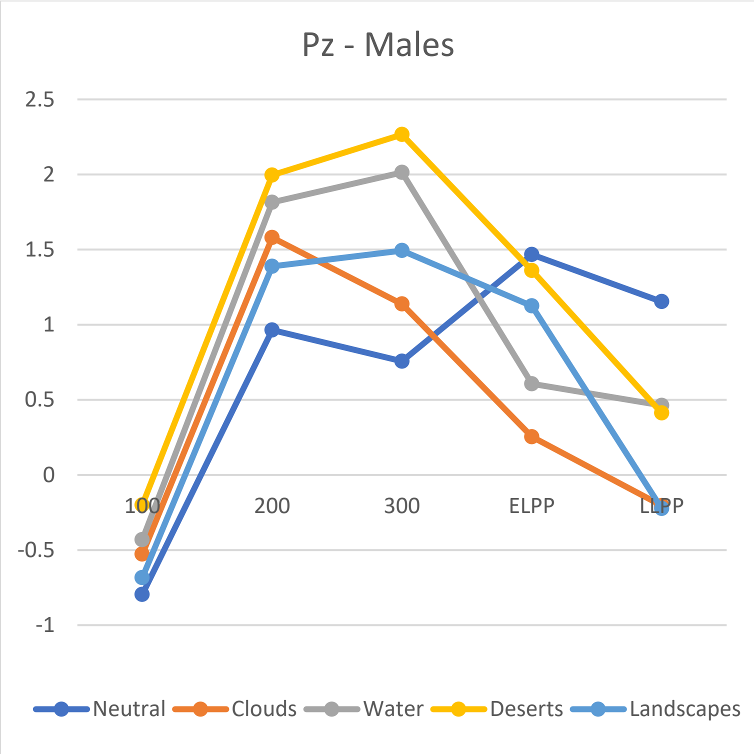


Figure 244. Mean average ERP amplitude (µV) for the male participants in response to each image category, across epochs for the Pz measurement site

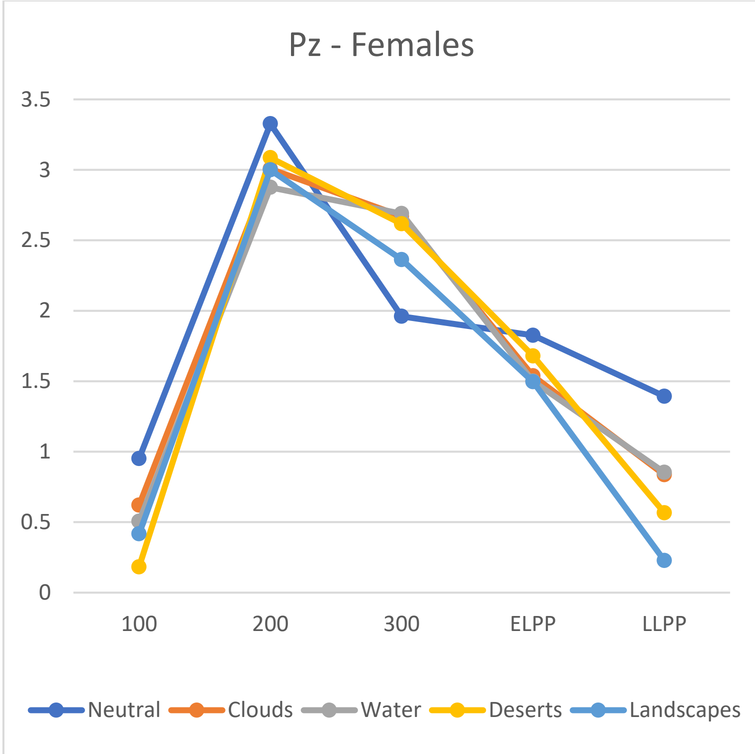


Figure 245. Mean average ERP amplitude (µV) for the female participants in response to each image category, across epochs for the Pz measurement site

6.6 Discussion

The aim of this research was to investigate the neutrality of currently accepted IAPS neutral stimuli and the impact of its apparent highly confounded nature. In order to quantify this, differences in ERP activation towards the IAPS neutral images and a selection of alternative images extracted from royalty free internet sources were measured. These were photographs of Landscapes, Deserts, Water and Clouds. These alternative images had their content assessed (and potentially modified) to remove the maximal amount of confounds but maintained their real context.

Based on the prior research of this thesis and many published articles (e.g. Fletcher-Watson et al., 2008; Groen, Ghebreab, Lamme, & Scholte, 2016; Groen, Ghebreab, Prins, Lamme, & Scholte, 2013; Lithari et al., 2010; Schupp, Cuthbert, et al., 2004; Schupp, Junghofer, et al., 2004; Schupp et al., 2006), it was hypothesised that there would be differences in ERP amplitude between the five image categories; the IAPS Neutral category would evoke maximal response; there would be both between and within sex differences in response towards the categories. Overall, results demonstrated that there were several significant main effects of image and sex across site and epoch. This was the case for both between and within sex analysis. Furthermore, interactions showed that the effect of image was not consistent across sex.

As hypothesised, there were significant sex differences found in response to the image categories. Overall, males tended to respond with a reduced mean activation across all sites except from at the Cz cluster where the male response was found to be significantly increased in comparison to females. Whereas, females tended to respond with increased negativity over the frontal sites across early epochs and increased positivity at the parietal site in comparison to males. This supported research suggesting that there were sex differences in visual processing (e.g. Glaser, Mendrek, Germain, Lakis, & Lavoie, 2012; Lithari et al., 2010; Lusk, Carr, Ranson, & Felmingham, 2017; Lykins, Meana, & Strauss, 2008; Ruigrok et al., 2014; Rupp & Wallen, 2008; Victor, Drevets, Misaki, Bodurka, & Savitz, 2017) and these results were in line with the early negativity bias (Lithari et al., 2010).

However, it should be noted that the negativity bias proposed that females respond with an increased negativity towards negative stimuli whilst here, the effect has been shown in response to stimuli rated as neutral. Previous research and investigation has reported that females have been more selectively attentive towards biologically relevant stimuli rated high for negative valence (i.e. fear and sadness inducing content) (Lee et al., 2017; Lithari et al., 2010; Whittle et al., 2011) and have shown sensitivity towards emotional information and an increased responsiveness and sensitivity towards unpleasant stimuli such as sad faces (Lee et al., 2017; Li et al., 2008; Meaux, Hernandez, et al., 2014; Meaux, Roux, et al., 2014). This may go some way to explaining why females have shown twice the likelihood of experiencing psychiatric issues in comparison to males (Albert, 2015; Victor et al., 2017). The current research has extended these findings and has shown that females tend to respond significantly differently from males towards images that have been rated as neutral on scales of valence, arousal and dominance. Thus, demonstrating that neutral content stimuli continue to evoke sex differences in visual processing that have been previously linked with affective and emotive content (e.g. Lithari et al., 2010). This has implied that there are inherent sex differences in neurological activation and cognition regardless of visual stimuli content and/or there continues to be important questions to be raised regarding the neutrality of neutral content due to the inference that neutral content was emotive and causal of the sex differences found. This element has also supported previous results within the succession of thesis chapters and has further reemphasized the need to include sex as an independent variable in all future research.

Despite the growing understanding of stimuli content effects (i.e. in response to emotive content such as violent, erotic, fear and disgust), to date, there has been no known research directly investigating the impact of content with multiple confounds (i.e. each image has the potential to be a new category and within each image, there are likely to be multiple confounds) of neutral images and only a limited selection of researchers have investigated the processing of certain types of images (e.g. scenes) used within the IAPS neutral category using electrophysiological methodologies (Cichy, Khosla, Pantazis, & Oliva, 2017; Groen, Ghebreab, Lamme, & Scholte, 2016; Groen, Ghebreab, Prins, Lamme, & Scholte, 2013; Ramkumar, Hansen, Pannasch, & Loschky, 2016). What has been documented from contemporary findings has been that complex visual scenes evoked increased P200 components with image properties such as spatial expanse (open/closed), relative distance (near/far), and naturalness (man-made/natural) having an effect on response (Harel et al., 2016). Chai and Jacobs (2009) investigated directional and positional cues when navigating 3-D virtual landscapes. Males showed a navigation advantage and encoded gradient cues (i.e. terrain slants) more effectively than females. This may explain the extensive sex differences in response to landscape type images (e.g. Landscapes and Deserts). Traditionally task performance has favoured males in visuospatial tasks (McGlone, 1980; Davidson et al, 1990; Rescher and Rappelsberger, 1999; Gur et al, 2000; Coney, 2002; Clements et al, 2006). Thus, males may have an advantage in processing of images requiring rapid analysis of full, complex landscape content.

Although modulation of the P200 has been established as an ERP marker for scene processing (e.g. Harel et al., 2016), Ferrari, Codispoti, Cardinale, and Bradley (2008) suggested that the N200 component reflected perceptual fluency and was attenuated when the current stimulus matched an active memory therefore, response across the 200ms epoch could reflect memory perception and retrieval. However, these explications can only go so far to explaining the current results (i.e. the majority of the stimuli used were scenes). It cannot explain the seemingly extensive differences in activation found towards image categories across other epoch and measurement sites. Nonetheless, the facts are that there were significant differences in ERP amplitude between image categories deemed neutral in content. These current findings have implied that only one type of image should be used as a baseline neutral in future studies. Furthermore, based on the main effects of sex and image across sites and epochs, results have demonstrated that the most appropriate category type was dependent on many methodological factors for example; measurement site, epoch and IV's such as participant sex.

Since there has been a plethora of research that has shown stimuli content has an effect on neurological response (e.g. Lithari et al., 2010; Olofsson, Nordin, Sequeira, & Polich, 2008), it had been deduced that a category of confounded content would likely produce a greater neurological activation in comparison to a stimuli category with reduced confounds. Subsequently it was suggested that there would be a greater mean ERP response towards the IAPS Neutral category in comparison to the alternative categories. However, current results indicated that this was not the case. Instead, the response towards the IAPS neutral images tended to evoke a mean amplitude that was approximately mid-range between the categories (see Ch 6.5.3 Graphs for visual representation). Complex scenes (Landscapes and Deserts) evoked the greatest mean response and the Clouds and Water categories tended to induce the most minimal activation. This notable finding could be explained quite simply. Due to the fact that the IAPS neutral images have an unspecified amount of confounds within many image subcategories, each one of these have the potential to produce unpredictable changes in participant response. Thus, the overall result produced in this research was an averaged amplitude of all the confounded images.

Based on the above, it seems plausible that scenes with minimal content (e.g. clouds and water) required a reduced cognitive load in processing resources as the full image was repetitive and without 'hidden' focal points. Opposingly, complex and cluttered scenes (e.g. landscapes and deserts) may have required additional resources for processing due to image scanning and content detection (Cichy, Khosla, Pantazis, & Oliva, 2017; Groen, Ghebreab, Lamme, & Scholte, 2016; Groen, Ghebreab, Prins, Lamme, & Scholte, 2013; Ramkumar, Hansen, Pannasch, & Loschky, 2016). Current results supported this as despite the evidential significant differences found in response to image categories (see Tables 96-101.), there were no instances where there were significant differences found between Cloud and Water categories and both categories tended to evoke minimal ERP responses in comparison to all other categories. However, one alternative explanation that was considered was the effect of colour (Bredart, Cornet, & Rakic, 2014; Cano et al., 2009). Both the Water and Cloud images were predominantly blue in colour. It may be possible that as the majority of each stimuli was one colour, this had a non-excitatory effect.

According to Spence et al. (2006) colour is inherently important in processing and acts to enhance scene recognition in a dual manner; to improve surface segmentation and edge detection (Fine, MacLeod, & Boynton, 2002) and aid in visual memory (Bredart et al., 2014; Goffaux et al., 2005; Rossion & Pourtois, 2004; Wichmann, Sharpe, & Gegenfurtner, 2002). Yoto, Katsuura, Iwanaga, and Shimomura (2007) investigated the effects of object colours on both blood pressure and EEG response. There was no effect of colour found for blood pressure however, it was shown that there were significant mean differences in EEG responses towards the red, yellow and blue stimuli. It was concluded that there was support for the possibility that the colour red elicited a state of anxiety and as a result, evoked an increased neurological activation in relation to perception and attention in comparison to the colour blue. Although this research used coloured paper swatches in comparison to real content (e.g. clouds or water), it has suggested that images with a predominant blue hue would evoke minimal responses in comparison to those with a red or yellow hue (i.e. Desert images). Further research would be required to establish the effect of the colour green (e.g. landscapes).

In addition, colour has been understood to affect attention (Yoto et al., 2007), mood and emotion (Küller, Ballal, Laike, Mikellides, & Tonello, 2006). Emotion has been shown to modulate response towards affective imagery (Ding et al., 2017). Therefore, slight changes in the colours of any given neutral stimuli could modify response towards that stimuli. For instance, if a landscape image had dark grey, anvil-topped cumulonimbus clouds in the back ground and a duplicate image had minimal white fluffy cirrostratus clouds, it would be expected that there would be a moderating effect of colour (and possibly cloud shape) on neurological response. Although, the sets of alternative images used within this research were modified to remove foreign objects or focal points (i.e. birds, pylons, sheep, tumbleweeds etc), there was no measurement or modification of hue and saturation made. Thus, effects of these cannot be speculated. This would benefit from further investigation and consideration.

In addition, reflection should be given to understanding whether there was an effect of relevance and recent active memories. For example, this research has employed the participation of the British public, most of whom would be expected to have been witness to the country landscapes depicted within the landscape images. Thus, these would have been an active memory (potentially memory evoking), possibly personally relevant. However, the image of a desert would not be as normalised for those participants. Ferrari et al. (2008) suggested that N200 reflected perceptual fluency and was attenuated when a current stimulus matched an active memory representation and that the amplitude of the P300 component reflected stimulus meaning and significance. The current research found maximal differences across the 200ms and 300ms epochs for both males and females (see Ch 6.5 Results). Thus, suggested that certain stimuli may have matched active memories and was thus, emotive rather than neutral. Again, questioning the validity of using amalgamated or complex scenes as neutral stimuli.

Similarly, Schupp et al. (2006) proposed that the amplitude of the N200 component reflected selective attention towards task relevant content for example the stimuli content, colour and shape especially during danger and threat assessment. Considering that many of the strongest significant effects (as suggested by the F ratio and associated p values) were found over the 200ms epoch for sex at every location and similar for the main effect of image for every location except for across the Pz cluster, it has provided compelling evidence and reasoning for additional examination. Further investigation should aim to consider whether colour (i.e. using alternative colours with the same image), content relevance or the 'single content' was the primary influence in current findings (potentially increased processing speed and/ or reduced resource demand). Irrespective, these findings emphasized the original assumptions; complex scenes or categories with an amalgamated and unpredictable content should not be used as a neutral stimulus due to their confounded nature and clear notable effects on neurological response.

Crucially, as previously seen in prior research (e.g. see Ch 3, 4 & 5) there were several significant differences found in response to the IAPS neutral category. These have provided conclusive evidence to suggest that the neutrality of neutral images continues to be questionable and the use of stimuli with the variety of confounds as highlighted, is debatable. By definition, there should be zero (or at the most, minimal) differences in evoked response towards a stimulus collection viewed as baseline. However, there were significant differences found in response to all image categories. Based on the results, it can be concluded that there was no one ideal category that could be viewed as superior to the others, however, inspection of the graphs (see Figures 220 - 235) has identified that both Clouds and Water images tended to evoke a minimal response, especially over the Fz, Fcz and Cz clusters. The Pz cluster showed that the IAPS Neutral images produced maximal amplitude (both negative and positive mean voltage) for both males and females in comparison to the other image categories. Therefore, the IAPS neutral images can offer no consistency across epochs despite showing a minimal response over the 300ms epoch at the Pz location. Furthermore, this research has suggested that the category that could be viewed as best practice would be dependent on which measurement site and epoch (and key factors such as sex) would be used during investigation. This adds to research calling for closer scrutiny and standardisation for stimuli employed (e.g. Mikels et al., 2005; Murphy et al., 2010; Schneider et al., 2016).

An objective of future research should extend these findings with the aim of understanding the effects of content variation across alternative image categories (i.e. what are the effects of the amalgamated category content of erotic, violent and disgust categories? The effect of fake verses real; same sex figures present). In sum, these results have made a compelling case for the notion that there is much more to the selection of presented stimuli than just the reliance on self-report rating scales. Here EEG measurement has shown that several multidisciplinary factors must be accounted for within stimuli selection (e.g. participant sex, image contents, contexts and overall image quality) and furthermore, that there is a need for a contemporary stimuli catalogue to be formulated with sufficient divisions made to ensure presented stimuli would be adequate in number and fit for purpose. However, caution should be taken to ensure that neutrality is not deemed as simply ‘the removal of emotive content’. A neutral stimuli in this context is not a manipulation of a violent/ erotic/ disgust image to remove the emotive element. What is meant here is that the removal of a weapon in a violent image does not make it a neutral image. Everything about that image will still be 'violent'; the body posture, the body language, the facial features/ emotive meaning (Mondlock, Nelson & Horner, 2013; Civile & Obhi, 2015). Thus, care should be taken to ensure that future construction of a stimuli catalogue identifies neutral images without conflicting/ incongruent features.

Regardless of consideration of these key elements of stimuli selection, the IAPS collection does not currently have enough images to enable the rigorous scrutiny of the appropriateness of images deemed any particular category. Especially in order to account for minimum requirements of stimuli for EEG research (e.g. between 20 – 100 dependant on component(s) under investigation (i.e. Cassidy, Robertson & O'Connell, 2012; Dickter & Kieffaber, 2014; Huffmeijer, Bakermans-Kranenburg, Alink, & van Ijzendoorn, 2014; Luck, 2014; 2017). Furthermore, it has been identified that each category currently holds several alternative subcategories (e.g. within neutral category; abstracts, clustered complex scenes; animals; human faces; simple scenes, historic objects, inanimate magnified objects, competitive sports) that cannot be accounted for due to the lack of stimuli quantity. It is therefore paramount that within any new collection of stimuli, sufficient numbers of category specific content are provided.

This research has clearly shown several underlying contributory issues with the provision of stimuli (and sub categories) that have inadvertently introduced many hidden layers of confounding factors and variability within every stimuli presentation. It has further urged for the unification of researchers to adopt a multidisciplinary approach in order to formulate and classify a standardised collection of 'best practice' stimuli. This would increase replicability, help maintain consistency and may increase research validity and reliability for the future.

6.7 Key Findings

There were significant effects of sex and image towards all image categories.

There were significant interactions that demonstrated that the effect of image was not consistent across sex.

Effects of image showed that females tended to demonstrate an increased negative activation in early epochs and an increased activation in later epochs towards neutral categories.

There were significant differences in processing between image categories

Clouds and Water scenes tended to evoke minimal response in comparison to other image categories.

Best practice category was shown to be dependent on factors such as participant sex, epoch, and measurement site.

Future research should work towards the development an appropriate standardized stimuli catalogue.

Chapter 7 **General Discussion**

7.1 Thesis Key Aims and Findings

Summarised below is each of the key aims and key findings for every chapter.

Chapter	Key Aims	Key Findings
Chapter 1: Thesis aims	Explore differences across component encapsulated epochs in neurological response towards affect imagery of differing content (i.e. violent, erotic, disgust and neutral) whilst employing current best practices in EEG. Explore some previously outlined alternative factors of aggression and investigate these in relation to the theoretical posits of the research field (e.g. Lifestyle choices/ experiences and demographic variables) Explore a baseline measure (e.g. what is neutral content). Advance understanding of image content with the development of neutral stimuli that could be used as an unbiased baseline measure and to adequately explore the viability of currently accepted stimuli.	

	Explore theoretical posits of response differences based on trait aggression scores and understand these in relation to theory Explore the effects of differing trait aggression score data analysis methodology on overall differences between high and low groups.	
Chapter 3	To conduct a pilot study investigating potential differences in emotional processing due to exposure to violent media employing a methodology that included essential procedures that have been outlined in the literature by EEG methodologists. Investigate differences between published research data that has had the methodology negatively critiqued and the results from this pilot study, to provide a baseline for further studies. Investigate potential differences in emotional processing due to alternative factors (e.g. sex, previous life experiences and lifestyle choices) when viewing affective imagery	There was insufficient evidence to support or refute the predictions of The General Aggression Model (Anderson & Bushman, 2002) and the Indirect Effects Model (Malamuth, 1986). However, there was some support for the Catalyst Model of Aggression (Ferguson, 2007). The results supported several key findings from previous literature for example; the early female negativity bias (Lithari et al., 2009); sex differences in visual stimuli processing (e.g. Lusk, Carr, Ranson, & Felmingham, 2017; Lykins, Meana, & Strauss, 2008; Ruigrok et al., 2014; Rupp & Wallen, 2008; Victor, Drevets, Misaki, Bodurka, & Savitz, 2017) and highlighted important

		avenues for further research. There were significant differences in emotional processing due to violent media. There were significant sex differences found in all epochs and sites in response to the image categories. There was no evidence to support the desensitisation effect in response to violent visual stimuli. There were significant differences found moderated by alternative factors (e.g. sex, previous life experiences and lifestyle choices) as specified in the literature.
Chapter 4	To conduct a large-scale study investigating potential differences in emotional processing due to exposure to violent media employing a methodology that included essential procedures that have been outlined in the literature by EEG methodologists. Investigate differences between published research data that has had the methodology negatively	There was insufficient evidence to support or refute the predictions of The General Aggression Model (Anderson & Bushman, 2002) and the Indirect Effects Model (Malamuth, 1986). This research supported the previous small-scale investigation (Ch.3.).

	critiqued and the results from this pilot study, to provide a baseline for further studies. Investigate potential differences in emotional processing due to alternative factors (e.g. sex, previous life experiences and lifestyle choices) when viewing affective imagery. Hypothesis 1. There will be sex differences in response to affective imagery Hypothesis 2. There will be differences in mean ERP response towards affective imagery based on preference towards violent and nonviolent media. Hypothesis 3. There will be differences in neurological response towards affective imagery based on previous exposure to a violent crime.	The results supported several key findings from previous literature for example; the early female negativity bias (Lithari et al., 2009); sex differences in visual stimuli processing (e.g. Lusk, Carr, Ranson, & Felmingham, 2017; Lykins, Meana, & Strauss, 2008; Ruigrok et al., 2014; Rupp & Wallen, 2008; Victor, Drevets, Misaki, Bodurka, & Savitz, 2017) and highlighted important avenues for further research such as stimuli content and context. There were significant sex differences found in all epochs and sites in response to the image categories. This suggested that biological sex moderated ERP response towards affective visual stimuli. Sex should be treated as an IV in EEG research. There was no evidence to support the desensitisation effect in response to violent visual stimuli. Although there were significant differences found between groups that were moderated by previous life experiences and lifestyle

		choices as specified in the literature, there was no consistency to the findings for within-sex analysis therefore, this identified a potential reliability issue with these IV's.
Chapter 5	Investigate differences between published research data that has had the methodology negatively critiqued and the results from the current study, to provide a baseline for further studies. Investigate the differences in ERP activation towards affective media based on total trait aggression scores (both between groups and within sex) using a standardised psychometric measure of aggression. Understand the effect of minor changes in data processing method (Cut off of 81; Media method; 25th and 75th Percentile or K-Clustering) and data grouping of dichotomous variables (High and Low aggression) has on overall ERP results & subsequent meaning of the findings. Hypothesis 1. There will be significant differences between those in high aggression groups in comparison to those in low	There was little convergence between data processing method adopted. Significance of results were dependant on data processing method adopted. This has the potential to lead to the selection of the method to enable a favourable outcome that seeks to support hypotheses. There was no evidence for the desensitisation effect. There was evidence to suggest that trait aggression moderated ERP response towards visual stimuli (Erotic, Violent, Disgust and Neutral). There was a within-sex effect that appeared to only be for male participants. Those in the high aggression groups predominantly responded with an increased ERP amplitude in comparison to

	aggression groups in response to affective imagery. These should be found between within-sex groups (i.e. differences between high and low females and high and low males) to demonstrate validity and reliability of the IV aggression as measured by the BPAQ. Hypothesis 2. There will be differences in results based on data processing method (Cut off of 81; Media method; 25th and 75th Percentile or K-Clustering).	those in the low aggression groups towards affective imagery. Questions have been raised regarding the confounding content of the images provided by the IAPS Future research should work towards the development an appropriate stimuli catalogue and a discriminating measure of aggression (e.g. biometric) however, both were beyond the scope of the current thesis.
Chapter 6	Investigate the differences in ERP activation towards neutral images from the IAPS and a selection of alternative images extracted from royalty free internet sources that have had their content addressed (and potentially modified) to remove the maximal amount of confounds. Hypothesis 1. There will be significant differences in ERP response between the image categories (Neutral, Landscape, Desert, Clouds, Water) across epochs. Hypothesis 2: There will be sex differences in response towards all image categories.	There were significant effects of sex and image towards all image categories. There were significant interactions that demonstrated that the effect of image was not consistent across sex. Effects of image showed that females tended to demonstrate an increased negative activation in early epochs and an increased activation in later epochs towards neutral categories. There were significant differences in processing between image categories

	Hypothesis 3. There will be significant within-sex differences in response between image categories Hypothesis 4. There will be greater activation in response to the IAPS Neutral category in comparison to the other four categories (Landscapes; Deserts; Clouds & Water).	Clouds and Water scenes tended to evoke minimal response in comparison to other image categories. Best practise category was shown to be dependent on factors such as participant sex, epoch, and measurement site. Future research should work towards the development an appropriate standardised stimuli catalogue.
Chapter 7 **Thesis Findings**		Aggression Methodology Data Processing Stimuli

7.2 Aggression & the Media

As has been previously stated, mass media is currently the largest grossing worldwide industry (Statista, 2017a, 2017b) with daily adult exposure calculated at an average of over 8 hours (J. Miller, 2014). Despite a fall in violent crime rates (e.g. ONS, 2017a, 2017c; Walby, Towers, & Francis, 2016), research has linked violent media with violent cognition and behaviour (e.g. Anderson & Bushman, 2001, 2002; Bartholow, Bushman, & Sestir, 2006; Beck, Boys, Rose, & Beck, 2012; Engelhardt, Bartholow, Kerr, et al., 2011; Engelhardt, Bartholow, & Saults, 2011; Huesmann, 2010; Jabr, Denke, Rawls & Lamm, 2018). Due to the many strong criticisms of the media research (e.g. Ferguson, 2007a, 2007b; Ferguson & Dyck, 2012; Ferguson, Garza, Jerabeck, Ramos, & Galindo, 2013; Ferguson & Kilburn, 2010; Ferguson, Smith, Miller-Stratton, Fritz, & Heinrich, 2008; Heene & Ferguson, 2017; Jerabeck & Ferguson, 2013; Ward, 2011), one main aim of the current research was to use current technology and standardised methodology to re-assess the foundations of the suggested media effects and to provide an unbiased empirical base to build upon in future research.

In spite of the mounting evidence that has failed to support the claims of a link between VM/EM exposure and increased violent cognition and behaviour, some contemporary research has continued to rely on these articles to build additional support for the causal relationship. For example, Jabr, Denke, Rawls, and Lamm (2018) suggested that they had supported research showing the desensitisation effect (Bartholow et al., 2006; Engelhardt, Bartholow, Kerr, et al., 2011). However, the authors made no link between the P300 and aggression and the research has fallen short of typically expected standards. They employed EEG technology whilst requiring participants to complete Rapid Serial Visual Presentation (RSVP) Task. Alike the oddball task, the RSVP task uses uneven categories of stimuli which has been shown to produce probability effects (see Ch 2.2.17.1 for overview) (Ferrari, Bradley, Codispoti, & Lang, 2010; Luck, 2014b; Rosenfeld, Biroschak, Kleschen, & Smith, 2005; Steiner, Brennan, Gonsalvez, & Barry, 2013). It was also suggested that the P300 component was measured as an indicator of aggression. This component is typically located around 300ms post stimuli presentation, Jabr et al. (2018) provided that this component would be measured between 450 – 750ms which is a timeframe commonly associated with the LPP (Renfroe, Bradley, Sege, & Bowers, 2016). Yet, by closely inspecting figures provided by Jabr, et al. (2018), it has suggested that the measured component was evoked considerably later than stated between 650 – 900ms.

Irrespective of timing, there was no evidence of the P300 reported as the evoked amplitude was shown to be negative therefore, was closer an N300 component. The N300 component has been shown to be a measure of expectancy (Sur and Sinha, 2009). Thus, Jabr et al. (2018) findings suggested that due to probability effects (consequence of the design) the component analysed was a measure of the level of expectancy towards the target images. Additionally, the authors have highlighted that the target images were selected from the IAPS image inventory based on their ratings on arousal and valence and unfortunately, the violent category contained images that were not considered violent. Several were of animals related to phobias (i.e. snakes and spiders) and hospital scenes that have been closer related to disgust content. Thus, claims that EEG was recorded in response to violent category images was disputable. Similarly, some of the neutral images used were more adequately viewed as violent content (i.e. depictions of ice hockey games) or with highly confounded content typically seen when ratings of arousal and valence defined the neutral group membership (see Ch 6. For overview)

Finally, and most importantly, many of the statistics reported by Jabr et al. (2018) as trend level statistics with significant trends described at levels such as p=0.06 and above. Gibbs and Gibbs (2015) stated that "applying the term trend to almost significant differences demonstrates a misunderstanding of the meaning of *P* values" (p.337). A *P* value (or calculated probability) describes the probability of finding the observed, or further extreme, results given that the null hypothesis is true (Field, 2013). If the probability is less than the author specified value (usually pre-defined at 0.05 or 0.01), the null can be rejected. Thus, the outcome of inferential testing are to either reject the null hypothesis or fail to reject the null. There can be no implication of "nearly accepted / rejected" where results have P values that fall close to the predefined alpha value (Gibbs & Gibbs, 2015).

Whilst being statistically incorrect, Jabr et al. (2018) used wording that discussed 'trends of significance', this type of clause is linguistically thought-provoking. The trend implies that non-significance is a mere step in the direction towards significance. Although understanding non-significant results on the cusp of alpha within data that are among a consortium of significant results could call for further detailed research (i.e. preliminary research with small sample sizes), in large scale, peer reviewed published articles, there is an expectation of a pinnacle of quality and transparency. Using terminology and language that leads a general reader to believe that the data has shown a trend towards 'significance' is misleading especially when there is no such movement of statistical values, in any direction; there are only significant or non-significant results.

These, among many more have been highlighted as issues pertaining the media research field and have consistently been emphasized across the field of aggression research. However, the tendency has been failure to address the issues or simply to overlook the standards expected leading to articles being constructed that linguistically mislead the reader (intentionally or otherwise). There must be no room for readers to review this type of reporting, as it could give the opinion of hidden agendas and produce and overall demise in the quality of the field.

The media-aggression link has flourished without any definitive definition of aggression. It seems that irrespective of time spent, an agreed definition of aggression still eludes theorists and researchers alike (Geen, 2001; Warburton & Anderson, 2015). Therefore, the empirical measurement of aggression has been without consistency. Throughout this research the current gold standard measurement tool has been adopted (i.e. the BPAQ, Buss & Perry, 1992) however, its use has instigated further questions regarding its suitability to the task (see Ch 5.). For example, the comparatively negligible difference of approximately 9% of the overall available breadth of scores on the BPAQ (Buss & Perry, 1992) between scores for known violent offenders and those for non-aggressive individuals appears a very narrow empirical band to differentiate such dipolar behaviour. Based on these suggestions, the notion that aggression could be philosophical seems a legitimate consideration for future exploration.

There can be no doubt that aggressive behaviour exists, and that deliberate, lethal interpersonal violent and aggressive acts have predated the media (e.g. from the Ionian stage) (Sala et al., 2015) yet, with the vast expansion of media outlets (i.e. television, smart phones, gaming consoles) detailing the ever-increasing depictions of violence and sexually violent content, there has yet to be evidence of the expected increase in violent crime. This has suggested that the measurement of aggression in research may not have been a valid measure and furthermore, the impact of the media has been inflated with alternative factors (environmental / biological/social) yet to be thoroughly investigated. Although heuristic models (i.e. the GAM: Anderson & Bushman, 2002; the CMoA: Ferguson et al, 2009) have included alternative factors in aggression such as social; economic; environmental; biological and neurochemical elements, the majority of the models offer very little acknowledgement of the relationship between modelled features and individual factors such as subjective experiences; lifestyle choices and preferences (Ferguson & Kilburn, 2010). Therefore, much more research would be required to fully enable both academics and the public to understand the effect of the media.

However, this research showed that results (and meaning) were dependent on data processing method adopted (see Ch. 5). Minor adaptions and modifications (i.e. median values used across the participant pool in comparison to the median value that was weighted by sex) of areas of data processing could allocate meaning and significance to certain results and not others. For example, a significant difference was found in the ELPP epoch over the parietal measurement cluster, between high and low total aggression scores for males in response towards violent IAPS images. This was the case for three methods (out of six). Thus, in 50% of the methods, it could have been concluded that aggression moderated response over the area and timeframe most commonly reported to show the link between aggression and media effects (Pz site over 450 – 650ms timeframe). However, the current research failed to replicate the effects of desensitisation due to the increased response being found for those in the high scoring group (HAM) in comparison to the low scoring group (LAM). Thus, this research has found no support for research reporting the irrefutable causal links between aggression and the media (e.g. Allen et al., 2018; Groves, Prot & Anderson, 2016) and has supported the continued need for replication research (Forstmeier et al., 2017; Stevens, 2017; Wagenmakers, 2007; Wagenmakers et al., 2012).

There was evidence to suggest that trait aggression moderated ERP response towards visual stimuli (Erotic, Violent, Disgust and Neutral). However, these findings were not specific to violent content. Rather, there was evidence to show that effects were found across all categories. Furthermore, those in the high aggression groups predominantly responded with an increased ERP amplitude in comparison to those in the low aggression groups towards affective imagery. These findings could support research that showed attention and interest was moderated towards content of interest (Bogaert, 2001; Nordström & Wiens, 2012; Schupp, Cuthbert, et al., 2004; Schupp et al., 2003). However, this would require follow up research using an appropriate collection of stimuli with greatly reduced confounds.

Overall, this has demonstrated that with the use of a standardised methodology, the link between media exposure and aggression is unclear and it has been shown beyond doubt, that small unjustified changes adopted during, and post experimentation can have magnifying or diminishing effects on results and meaning. Thus, for future, standardisation and method validation is paramount.

7.3 Methodology

Many elements of the methodology that has been used throughout the experimental chapters were adopted based on recommendations provided by field experts (e.g. Luck, 2014) and supported by transparent and contemporary research in the area (e.g. Lithari et al. 2010). However, it has been evident that many studies have failed to acknowledge the importance of standardisation and the influence that minor unjustified methodological decisions and assumptions could have on results and findings (see Ch. 2 for key points). For example, EEG research that has relied on digital filtering procedures to remove or attenuate frequencies external to their goals assumes that the data has normal distribution (Luck, 2014b; Zhang & Lee, 2012) however, the Gaussian assumption is only held true where no additional mental or physical action is required (Sanei & Chambers, 2007). Thus, even simple tasks that requires button depression (e.g. oddball tasks) would make disentangling the response difficult and any subsequent results, potentially invalid.

The unbalanced presentation of stimuli has been shown to cause probability and priming effects (e.g. Luck, 2014) (see subsection 2.2.17.1 for clarification). Barthelow et al. (2006) used 35 images; 25 neutral, 5 violent and 5 nonviolent. Engelhardt et al., (2011) also used 35 images; 4 context images (neutral) and 1 target image (violent) and presented them across 2 blocks of 48 trials. Despite the issues that the current research has raised regarding stimuli content and context, the highlighted unbalanced presentation could potentially provide reasoning for results. Additionally, some research has integrated several publishable research articles within one experimental procedure and have thus increased the number of stimuli used (and potentially content / category and context). For example, Engelhardt et al., (2011) conducted research with an additional 35 images external to the goals of the research in question. Thus, effects of these images can only be speculated.

Speculation as to the true meaning of activation in any one given area of the brain has led to the narrowing down of source location associations. However, the unjustified assumption that activation recorded for the P300 component found at the Pz electrode was directly related to aggression in response to violent media (e.g. Bartholow et al., 2006; Engelhardt et al., 2011) has still yet to be validated. It has been shown that ERP amplitude recorded over the P300 component over the parietal lobe has been viewed as a marker for many alternative variables such as the regulation of feelings of love (Langeslag & van Strien, 2016), motivated interest (Schupp, Cuthbert, et al., 2004), decision making (Twomey, Murphy, Kelly, & O'Connell, 2015), personality (Roslan et al., 2017) and for hypnotic responsiveness (Jensen, Barabasz, & Warner, 2001). Many of which appear contradictory to the notion of aggression.

Ferguson, Smith, Miller-Stratton, Fritz, and Heinrich (2008) recommended a version of the TRCTT in an attempt to standardise the field however, to date, there has been no known validation of this particular variant of aggression measure and no uptake in the use thereof (Elson, 2016; Elson, Mohseni, Breuer, Scharkow, & Quandt, 2014). Where research has adopted modified techniques, Elson (2014) argued that effort should be made towards offering the reader the benefit of knowing what changes would be found on results if there had have been a standardised version of measurement employed. This would likely require additional investigation or interpretation by the original author, or, would require the provision of enough information for the findings to be reproduced and be used in a comparison study.

However, replicability of research and reproducibility of results in the field have been very low (potentially due to many factors e.g. stimuli). Even when standard statistical controls have been relaxed results have not converged (e.g. Szycik et al., 2017). Both replicability and reproduction have been identified as widespread issues intrinsic within psychology (Stevens, 2017; Witte & Zenker, 2017). This could be due to the culture that has had an emphasis on novelty or the development of weak hypothesis formulation (Heene & Ferguson, 2017). Irrespective of whether these are true, future progression dictates that alternative procedures must be adopted. There have been several suggestions for ways in which to reduce these problems. For example, the consistent challenging nature of empirical investigation and replication research should be encouraged, and expected, without fear of repercussion, intention questioning and shamming (Bohannon, 2014; Stevens, 2017). In addition, the adoption of statistical analysis techniques such as power calculations that show the strength of relationships to be included, or for the move away from significance testing towards a Bayesian approach (Wagenmakers, 2007) that enables researchers to test the strength of evidence and show the probability of the hypothesis given the data inputted (Stevens, 2017).

7.4 Data Processing

The media research field has used a contrasting selection of data gathering, processing and analysis techniques. This has been typical and expected across research seeking to progress. However, where no agreed techniques have been provided, it has enabled the potential for post hoc decisions to effect results (see Ch.5). For example, where a method of data processing has been regarded as exemplary (e.g. using mean values) there would be no need to adopt another version especially, without any justification being provided (see Elson, 2016). However, as was detailed previously, many modified variants of this method have been employed that could have had an influence on results. This research has identified, and illustrated, that major differences can be found in results and potential meaning thereof, when minor manipulations have been carried out in data processing technique using the same data (see Ch. 5). This has supported the need for clear reasoning, justification and reporting.

7.5 Stimuli

Theoretical frameworks and models (i.e. The GAM; the CMoA; The CM; The IEM) have identified many factors (i.e. aggression, previous experiences of violent crime, childhood violence; age; I.Q.) that have been shown to modulate or moderate neurological response (see Ch. 1 for overview). As has been provided, this research has shown there were significant differences found in response to all stimuli categories (Violent, Erotic, Disgust & Neutral), across all epochs (100ms, 200ms, 300ms, ELPP & LLPP) and measurement site (Fz, Fcz, Cz, Pz, T7 & T8), based on several variables (i.e. sex, previous witness to violent crime; preference towards VM; total aggression scores). Taken overall, this has supported the suggestion that the confounded nature of the stimuli presented could have contributed to these findings. Although it can be understood that there are many factors that could influence response, any occasion when there are several significant differences found in response to a neutral set of stimuli raises questions regarding its neutrality and whether it is fit for purpose (see Ch.6).

Nonetheless, due to the provision of the highly regarded IAPS inventory, stimuli content and context have been overlooked. There has been a focus on arousal and valance ratings to dictate category group without consideration of actual content and context. This series of experiments have clearly highlighted issues with a confounded stimuli inventory and has urged for the standardisation across data processing, methodology and stimuli with future focus on the formulation of a suitable stimuli collection. Furthermore, this succession of research has identified that there should be additional factors considered in order to gather and produce a new suitable stimuli catalogue and potentially inform a standard for stimuli. Thus, outlined below are some methodological, participant, content and stimuli factors that require future consideration and accommodation (see Figure 246).

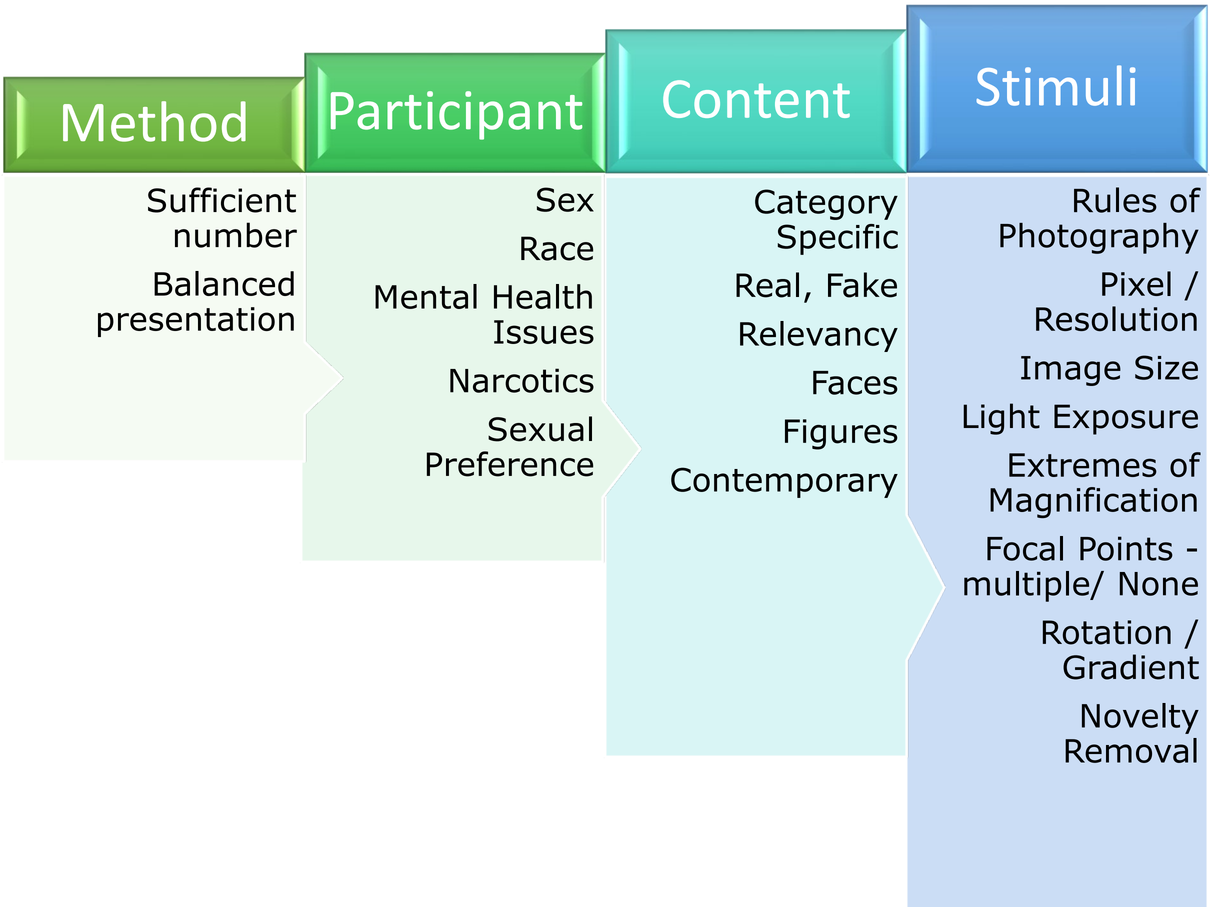


Figure 246. Key Factors for Consideration and Accommodation in research and Future stimuli catalogue development

In the following subsections (Ch 7.5.1 – 7.5.4), each factor (Methodology, Participant, Content & Stimuli) has been discussed separately to demonstrate their relevance. These are not an exhaustive list of potential influencing factors as many additional factors have been suggested to have an effect on aggression and / or processing of visual stimuli, however, these have been considered important and pertinent to the progression of this research and for use in the development of an appropriate stimuli collection.

7.5.1 Methodology Factors

It can be assumed that there are many methodological factors that have an influence on response and it should be expected that traditional quantitative method procedures are adhered to dependent on design. For example, the randomised presentation of stimuli to reduce the likelihood of skewed results based on probability effects (e.g. Ferrari, Bradley, Codispoti, & Lang, 2010; Luck, 2014b; Rosenfeld, Biroschak, Kleschen, & Smith, 2005; Steiner, Brennan, Gonsalvez, & Barry, 2013) would be expected however, certain methodological designs would confound this (i.e. the Oddball task or the RSVP task). Additional key methodological factors for consideration have been outlined below.

7.5.1.1 Stimuli number

EEG methodologists (i.e. Cassidy, Robertson & O'Connell, 2012; Dickter & Kieffaber, 2014; Luck, 2014) have suggested that there should be a minimum of stimuli presented in order to reduce the chance of producing erroneous and misrepresentative results. Therefore, each category would require a minimum of 20 images per category. More than this would be beneficial to allow researcher choice.

7.5.1.2 Balanced Presentation

Typically, a balanced presentation of stimuli is used to reduce potential skew of results (Luck, 2014). In line with this assumption, when selecting images suitable for presentation, the sex of content figures must be accounted for to enable an equal distribution of within content males and females where the methodology requires this (i.e. a balanced presentation with participant sex accounted for). Therefore, presented images should be balanced for both participant sex and sexual preference. Especially for erotic content where a nonspecificity of interest was reported for heterosexual females in response to both male and female content figures in comparison to males or homosexual females (e.g. Chivers et al. 2007; Rupp & Wallen, 2007, 2008; Wallen & Rupp, 2010).

7.5.2 Participant Factors

Many participant factors (i.e. age; I.Q. emotion; narcotic user) have been highlighted in neurological research and have been included in theoretical frameworks as reasoning for potential contributory elements of aggressive behaviour and cognition (e.g. see the CMoA (Ferguson, Rueda, et al., 2008; the GAM (Anderson & Bushman, 2001)). Outlined below are some key factors that have been considered and / or accounted for within this research and would require continued accommodation for future.

7.5.2.1 Sex

Within media research using EEG technology, there has been a tendency to treat sex as homogenous for ERP analysis (e.g. Bartholow et al., 2006: Jabr et al, 2018) or use a single sex population (e.g. Engelhardt et al., 2011) and then extrapolation of findings across sex. Sex differences in neurological response towards visual stimuli have been clearly demonstrated in both previous research (e.g. Lithari et al, 2011) and throughout all experimental chapters of this thesis (see Ch3, 4, 5 & 6). Participant sex has repeated defined response towards differing content and have distinguished response between groups across time and location. This has identified that sex must be considered as an IV and accounted for within future research and analysis. Future research may broaden the horizon to consider any differences in neurological response towards the differencing categories of stimuli content (e.g. violent, erotic, disgust, neutral) based on gender to enrich research that has traditionally considered biological sex.

7.5.2.2 Race

Own-race bias in the neural signature has been reported (Wiese, Kaufmann, & Schweinberger, 2014). Except from Ch 3 (pilot study), all experimental chapters required participants to identify as White, British to remove the effect of race. However, going forwards, the race of both the participant and stimuli figure requires consideration to develop an inclusive, rather than exclusive, collection of suitable stimuli and to develop cross cultural understanding of any media effect.

7.5.2.3 Psychopathological elements / Mental Health Issues

Psychopathological risk factors for aggressive behaviour have been investigated (Comai et al., 2016; Siever, 2008) and it has been made clear that many mental health issues could have a contributory influence on aggression (Robitaille et al., 2017) and have been linked to changes in neurological activation (Comai et al., 2016; Duffy, D'Angelo, Rotenberg, & Gonzalez-Heydrich, 2015; Reidy, Zeichner, Foster, & Martinez, 2008; Reidy, Zeichner, & Seibert, 2011; Tonnaer, Siep, van Zutphen, Arntz, & Cima, 2017). During the construction of the IAPS and the formation of the technical manual (Lang et al, 2008), there appeared to be no discussion of whether participation required those with known mental health issues to have their data removed or whether their data was segregated and tested in direct comparison to those without known issues to understand the data consistency. Simple screening for participation should aid in ensuring that initially, participants with no known psychological problems were employed for baseline measures.

7.5.2.4 Sexual Preference

Attention, interest and focal gaze increase where content is relevant to biological drives (Lykins, Meana, & Kambe, 2006; Lykins et al., 2008;

Proverbio, Riva, Martin, & Zani, 2010; Schupp et al., 2000; Schupp, Cuthbert, et al., 2004; Schupp et al., 2003). Especially when that content is considered appeasing and preferential (Bogaert, 2001; Proverbio et al., 2010). This may stem from the knowledge that sexually dimorphic facial features provide crucial information regarding the superiority of a future mate (Clutton-Brock & Huchard, 2013; Puts, 2016). Studies have identified that heterosexual individuals have a preference to view attractive faces of the opposite sex compared to same sex and that homosexual participants increase similar response across the same brain regions as heterosexual participants when viewing heir preferred sex stimuli (Conway, Jones, DeBruine, & Little, 2008; Rahman & Yusuf, 2015). However, a non-specificity has been shown for females in comparison to males (Chivers et al., 2007) that may require additional focus when formulating a stimuli collection and providing balance for research.

Therefore, when selecting images suitable for presentation, the sex of content figures must be accounted for to enable an equal distribution of within content males and females where the methodology requires. However, there should be an accommodation for the participant sexual preference as there has been enough evidence that has demonstrated there was differences and modifications in neurological response based thereon.

7.5.3 Content Factors

7.5.3.1 Category Specificity

Although this factor appears self-explanatory, category membership must be defined by content and context alongside ratings. For example; the IAPS inventory currently provides two images both understood to be violent content. One of a male holding a gun and another of a boy holding a gun. These two images maybe rated similar on valence and arousal. However, the age of the figure could be viewed as an important factor and should create the basis for another category of child violence / adult violence. Similarly, neutral images that depict a scene without a figure placed within should be categorised differently to scenes with figures (i.e. fishing scenes). Lastly, erotic content that has one individual present may be processed differently to images with more than one person present or where the pictured act is morally, emotive or physically very different to another within the same category. Content and category specificity should be paramount to image inclusion in research. Careful consideration of these elements should be taken in conjunction with ratings to provide tightly relatable category content.

7.5.3.2 Real, Reality, Fake, Fantasy

Ramos, Ferguson, Frailing, and Romero-Ramirez (2013) stated that individuals elicit a stronger response to media content that was understood to be real in comparison to content that was faked or posed. Many of the images provided by the IAPS appear to have been posed. Thus, new categories of stimuli should attempt to provide realistic content across categories. For example, humans read emotion and meaning from facial features (Seidel, Habel, Kirschner, Gur, & Derntl, 2010) and facial expression negotiates social action and behavioural intent (Crivelli & Fridlund, 2018; Schindler et al., 2017) where stimuli has been used in an attempt to investigate real world responses and behaviours, faked content could confound response. It can be understood that difficulty could arise in predicting participant perception regarding belief of content reality due to the subjective nature of perception (i.e. Does the participant believe what they are seeing is truly occurring?) however, categories should be specific and not mix reality with fantasy or posed with real content unless the research design requires this distinction.

7.5.3.3 Relevancy

The collection of images that are to be selected by the researcher must be relevant to their experiment. It is appreciated that this may seem obvious however, even the use of presumed neutral images that depicts a scene of approximately 70 years in the past (i.e. a 1950s style iron placed on a sideboard) would potentially evoke memories for some participants and confusion in others - potentially based on participant age (Kensinger & Leclerc, 2009). Both memory (Jaeger & Parente, 2008) and emotion (Ding et al., 2017; Hajcak et al., 2010; Schupp et al., 2003; Schupp et al., 2006) have been shown to modify the ERP response and unless the objective of the research is to investigate age / memory effects (e.g. Bridger et al., 2017; Kensinger & Leclerc, 2009), this type of image content would be irrelevant and counterproductive to the research requirements. Therefore, researchers should ensure that they are clear on their research objectives to enable careful selection of relevant stimuli content and to fully understand any potential changes there may be in response to irregular or irrelevant content.

7.5.3.4 Faces

Faces have been shown to have an impact on ERP response (Nemrodov, Niemeier, Patel, & Nestor, 2018; Olivares, Iglesias, Saavedra, Trujillo-Barreto, & Valdes-Sosa, 2015; Rossion, 2014; Rossion & Caharel, 2011; Victor et al., 2017). Research has found that early components (e.g. N170) and epochs (100 and 200ms post stimuli presentation) have been associated with facial recognition and processing (Fan et al., 2015; Feuerriegel, Churches, Hofmann, et al., 2015) and sex differences have been identified in fac with females tending to be more responsive to emotional facial expressions in comparison to males (Kato & Takeda, 2017).

Due to IAPS stimuli category foundation being dependent on arousal and valence ratings only, it encourages a mismatched formation of categories. Even those considered neutral content have a potential unbalanced collection of faces (across a variety of angles and depths) and no faces present (i.e. landscapes or buttons) that are interspersed with non-human faces (cute juvenile animal faces). This is typical of current category inclusion. There would likely be processing differences based on facial content and moreover, differences related to human or non-human face depictions. Thus, careful consideration would be required as to whether the processing of faces and facial features could affect results of any research that amalgamated face and no-face categories within their stimuli. Based on the current findings throughout this thesis, it would be argued that dependent on the study aims, research should provide either all faces/ no faces throughout or, an equal representation of face/ non-face images within each category. Similar equal distribution for non-human faces.

7.5.3.5 Figures

As suggested above, faces have been viewed as universal carriers of information. However, recently there has been behavioural and neuroimaging research that has identified the importance of bodily expressions and have shown that recognition performance is similar to that of faces (de Gelder, de Borst, & Watson, 2015). Taken together, research has shown that there is a rapid integration of facial features and body expression (Meeren, van Heijnsbergen, & de Gelder, 2005) in visual processing with dynamic body movement portraying information about emotions, actions and intentions (Borhani, Ladavas, Maier, Avenanti, & Bertini, 2015; de Gelder et al., 2015). Recently a study examined the N170 (a component commonly sensitive to facial recognition) as a marker of figure processing that compared clothed and nude figures (Hietanen & Nummenmaa, 2011). A linear increase in ERP amplitude was found in response to reduced clothing / increased nudity for both males and females. The figure evoked N170 response was found to be larger than that in response to faces and was found irrespective of the presence of the figures face (Hietanen & Nummenmaa, 2011). However, moderated responses towards figures have been found during later epochs (e.g. 200-500ms post stimuli presentation) and Waismann, Fenwick, Wilson, Hewett and Lumsden (2003) suggested that the P600 component was a strong indicator for preference towards erotic figures in males with differences in ERP amplitude between paraphilic and heterosexual stimuli across right parietal regions (P4 electrode). However, it must be noted that the stimuli used appeared confounded as there were an amalgamation of potentially unbalanced content (i.e. stimuli consisted of 57 paraphilic slides (depicting fetishistic and sadomasochistic themes), 57 heterosexual erotic slides (explicit pictures of nude women, coitus, and oral sex), and 57 neutral slides (landscapes and street scenes)) and no speculation can be made regarding a female sample. Nonetheless, clear evidence of neurological responses towards figures have been provided within the literature.

Most interestingly it has been suggested that the perception of figures and body expressions trigger adaptive action and behaviours (de Gelder et al., 2015). Thus, taken in the context of media research, it could suggest that the presence of a figure and the body expressions perceived from that figure would have as much importance as the presence of a face or a weapon in a violent image. Thus, where current neutral images provided by the IAPS have an unspecified amount that have figures present (e.g. a man stood riverside fishing) and an unspecified number of images without a figure present (e.g. the enlarged face of a cute puppy or a scene of a landscape) these extensive unknown confounds could explain some of the neural differences in activation among research. Thus, for a future stimuli catalogue, image categories would require further subcategorization to include those with and without figures. In addition, based on research that has shown sex differences in response to same or opposing sex stimuli figures, accommodation for the sex of content figures must be accounted for to enable an equal distribution of within-content males and females where the design requires.

7.5.3.6 Contemporary

This factor has links with the relevancy section above. By making the stimuli content relevant to the participant, in one sense it may mean removing images that are historic if the participant pool were from the younger generation. However, an alternative meaning of this factor would be understood when considering erotic stimuli for example. There are currently an abundance on erotic stimuli for use within the IAPS catalogue, however, many of whom could be viewed as outdated (in comparison to content currently depicted within the media or freely available over the internet) and may even be considered fetish at the current date. However, trends change thus, ensuring the availability of subcategories for researchers to ‘opt for’ would be preferential. This would allow user digression over content whilst acknowledging current trends to inform their requirements.

7.5.4 Stimuli Factors

This subsection refers to key factors that were identified during the use of the images as provided by the IAPS that may have had a contributory or confounding influence. During the experimental chapters of this research many of the following factors have been outlined and their importance explained. For example, requiring full colour images to be used where reality is required (i.e. media research) (Badia, Myers, Boecker, Culpepper, & Harsh, 1991) yet, a subsection of black and white images could be provided should there be need. However, the issue would be where there was an unjustified amalgamated content of colour and black and white stimuli. These factors could provide a base for a more adequate stimuli catalogue and a platform to identify expected standards.

7.5.4.1 Rules of Photography

It was explained in Ch 6 that one major aspect of using still images requires a multidisciplinary approach to consider the quality of image construction and a rudimentary understanding of the art of photography. Unfortunately, previous stimuli collections have failed to adhere to some of these very basic rules of photography, for example, the rule of thirds (Long et al., 2011). This composition rule ensures that the image and content, are balanced (Davis, 2011; Long et al., 2011; Sahlin, 2011). It has been shown that by adhering to this rule the quality of the photograph is considered high (Long et al., 2011). There has been no known EEG research that has considered the effects of using images that have adhered to basic rules in comparison to those who have not. However, eye tracking research has shown that attention is drawn to objects of novelty, surprise or emotive content (Armstrong & Olatunji, 2012; Falco, Jiang, Fan, Ma, & Wang, 2015; Nummenmaa, Hyona, & Calvo, 2006; Rupp & Wallen, 2007; Vervoort, Trost, Prkachin, & Mueller, 2013) and without adequate stimuli formation focus may take longer to identify content features. In addition, there have been many composition techniques (i.e. symmetry and depth) that would require further investigation to identify whether the depth of content in a stimuli make it less relevant to the participant and subsequently less stimulatory. For instance, if a violent image has a man stood with a knife at what seems a relatively large distance away from the participant (image distance) would this have a less neurological excitatory effect in comparison to the appearance of the figure and weapon that appeared closer to observer and therefore, directly related to the observer.

7.5.4.2 Resolution/ Pixel Density

Image quality can be dictated by the resolution or pixel density (King, 2016). The visual system decodes external inputs and interprets reality (De Cesarei et al., 2013). This processing relies on the quality of the input and a number of studies have confirmed this via investigation of the underlying neural mechanisms of these processes using object identification (De Cesarei et al., 2013; Viggiano & Kutas, 2000). Image quality is subjective however, Peterson and Wolffsohn (2005) found that quality was perceived to reduce when pixel resolution fell below 767 x 56dpi or where the images were compressed in alternative formats (i.e. BMP or JPEG file types). Many of the IAPS images appear to have been previously modified or fall below an expected standard. Future accumulation of images must ensure image quality is upheld in order for a minimal pixel resolution to be adhered to.

7.5.4.3 Image Size

Due to the varying sizes of images provided currently, researchers who attempt to standardise the size of each image fall victim to distortion of the image quality due to resolution changes. Thus, it must be ensured that future images meet a standard of quality that would withstand slight modification for use across multiple disciplines.

7.5.4.4 Light Exposure

It has been long established that light can have an effect on both physiological responses and psychological responses (Badia et al., 1991). However, many of the stimuli provided by the IAPS inventory have either over, or under light exposure. Although there appears no known research directly investigating the effect of light exposure on EEG response towards stimuli however, exposure extremes make content potentially unfathomable especially when investigating early responses (<300ms). Thus, to ensure stimuli used is appropriate, image exposure should be held constant based on expected levels as provided in basic photography literature (e.g. McClelland & Eisman, 1999; Sahlin, 2011).

7.5.4.5 Magnification

Another consideration is the within-image magnification size of the object pictured. Photograph depth has been considered influential for detail capture (Sahlin, 2011) and where the eyes are led towards focal points. Whether the inclusion of differing object magnification would influence response is speculative. However, it would be likely that highly magnified closeups of emotive content would cause an increased response as it would be perceived as a direct effect on the participant or would evoke a startle reflex. Based on these suggestions, researchers should have the options to omit highly magnified or highly distant object depictions with the provision of sufficient stimuli per category, or, to provide a separate magnified category.

7.5.4.6 Focal Points

In some stimuli there may be multiple focal points (e.g. two people; two faces; opposite sex; one weapon; background scenery; unexpected objects) that can attract gaze (Eismann et al., 2011; Sahlin, 2011). Although weapon focus has been widely researched (Fawcett, 2013; Pickel, 2009; Pickel, Ross, & Truelove, 2006) and has suggested that very early focus is held on the weapon, to date, it is not known whether research has investigated the effects of multiple focal points. Nonetheless, multiple focal points remove the ability to decipher what the recorded response relates to and thus makes any conclusions drawn spurious. Removal of stimuli with multiple focal points would reduce this. Moreover, future development of a stimuli collection should contain focus to one content or context at once.

7.5.4.7 Rotation / Gradient

Sex differences in response to landscape type images (e.g. Landscapes and Deserts) were found in Ch 6. Traditionally, task performance has favoured males in visuospatial tasks (McGlone, 1980; Davidson et al, 1990; Rescher and Rappelsberger, 1999; Gur et al, 2000; Coney, 2002; Clements et al, 2006). Males may have an advantage in processing of images requiring rapid analysis of full, complex landscape content. Complex visual scenes evoked increased P200 components with image properties such as spatial expanse (open/closed), relative distance (near/far), and naturalness (man-made/natural) having an effect on response (Harel et al., 2016). Chai and Jacobs (2009) investigated directional and positional cues when navigating 3-D virtual landscapes. Males showed a navigation advantage and encoded gradient cues (i.e. terrain slants) more effectively than females. Thus, although a minor issue, this may offer some explanation towards the reasoning for sex differences and accommodation for this point should be made within research using a variety of subcategory images.

7.5.4.8 Novelty Removal.

Presented stimuli should evoke a response that directly relates to the content and context expected (Ferrari et al., 2010). Thus, unexpected content should be removed from any stimuli. For example, a desert landscape would not expect a lush green patch of grass growing in the image. Novel elements in stimuli should be removed as it would attract attention and gaze and induce a response that could not be disentangled from the response towards the intended content (e.g. Luck, 2014).

7.6 Sex Differences

Mounting scientific evidence has shown that many sex differences exist in structural neuroanatomy, neuropathology, neurodevelopment, cortical volume and factors influencing the asymmetric effect that sex has on brain development (for overview see Ruigrok et al, 2014). These sex differences have been associated with the joint influence of biological and environmental factors (McCarthy and Arnold, 2011). Research has demonstrated that prenatal hormones (Arnold and Breedlove, 1985, Phoenix et al., 1959), the immune system (Lenz et al., 2013), gene-expression (Kang et al, 2011), prenatal nutrition (DeLong, 1993, Heijmans et al., 2008), stress and prenatal infections (Bale et al., 2010), sex chromosomes and early nurturing (Cicchetti, 2013, Rutter et al., 2003) all have an impact on early development. It is therefore plausible that whilst sex differences exist in the biology and neurochemical function of the brain, the processing of the external environment would mirror these differences. In addition, it can be understood that across time, the sexes have engaged in, and with, different roles and environments (from the hunter – gatherer times through to types of games/toys the sexes typically engage with today). These differences could have set the sexes apart in the processing of external visual stimuli and more interestingly, in the processing of emotion in stimuli. Very little explanation has been offered in the literature regarding why there may be sex differences in ERP activation. In particular why females appear to show an early negativity bias (Lithari et al, 2010) and subsequent increased later epoch positivity in relation to presented visual stimuli. Yet, this research has supported these findings and has indicated a potential explanation

7.7 Key points

It must be the case that research becomes less concerned with fellow researcher allegiance and publication driven decision making and firmly becomes focused on scientific progression and researcher integrity. The first step for media and aggression research is to produce a stimuli collection that is fit for purpose and adopt the methodology as prescribed by field experts.

This research has shown that there must be standardisation of methods, data gathering and processing techniques with validation provided.

Key factors have been outlined for use in the development of a new stimuli collection and may be used to inform expected standards for stimuli use.

It has been identified throughout the thesis experimental chapters that sex should be considered as an independent variable within future research.

Chapter 8 **Concluding Summaries & Projections**

8.1 Results Summary

Evidence was provided that there were sex differences in neurological activation in response to affective stimuli. This highlighted the need for future research to accommodate for sex as an IV. There was no evidence to support the General Aggression Model (Anderson & Bushman, 2001); the Indirect Effects Model (Malamuth & Briere, 1989), or the desensitisation effect (e.g. Engelhardt et al., 2011). Therefore, no conclusion can be drawn regarding the direct effects of the media on the brain. It was clearly shown that there is a need for standardisation of EEG and data processing/ statistical manipulation methods. Additionally, it was identified that the currently adopted stimuli requires standardisation with the creation of a new database of appropriate and adequate stimuli.

8.2 Contributions Summary

This research has provided the field with definitive evidence that when employing methodology as recommended by contemporary methodologists, there was no evidence to show an effect of media. However, there was evidence to suggest that the currently accepted stimuli used across this, and many fields, requires updating. This must accommodate for all the key elements as highlighted in Ch. 7. Lastly, this research has demonstrated that aggression may be an invalid method of group allocation and that the gold standard method of aggression measure (the Buss & Perry Aggression Questionnaire, (Buss & Perry, 1992)) fails to adequately separate aggressive and non – aggressive individuals.

8.3 Limitations Summary

Type one errors (false positives) have been an intrinsic issue within neuroscience research and recent applications of EEG methods have experienced the same problems. However, by identifying hypotheses that were precise and by applying rigorous practical and statistical methods as recommended by experts within the field (i.e. EEG methodologists and psychological statistical experts), it was viewed that the occurrence of type one errors were minimised especially with the use of relatively conservative types of multiple comparison correction algorithms (i.e. Bonferroni) and the minimal factor analyses undertaken. Nonetheless, Forstmeier et al. (2017) provided an in depth discussion on the ease of producing such false positive results primarily due to the current proportion of published work with (i) decreased sample sizes, (ii) increased pursuit of novelty, (iii) various forms of multiple testing and researcher flexibility, and (iv) incorrect P-values and Luck and Gaspelin (2017) detailed how EEG research has fallen victim to the provision of statistically significant results.

Due to the use of the IAPS stimuli throughout this research, it has meant that all findings have been based on stimuli that has been shown to be confounded on several levels. Thus, with the use of a more adequate stimuli set, results may differ from those shown here.

Lastly, the variables used in ch3 and ch4 in relation to preference towards violent content, demonstrated inconsistency to the findings and possibly the reliability, for between sex and within sex variables. Although there has been little consistency throughout the thesis chapters in support for using the dichotomous variables, the coding process for these variables could have been improved using an alternative measurement process. One option could be to use additional sub-scales for participants to self-report/ rate themselves on that could help define category membership. For example, for videogame players, additional information such as how participants rate themselves as players (Likert scale) or how many hours they play/ watch violent films per week could be added. For the witness to violent crime IV, it could be beneficial to add a severity measure (as defined by the participant on a subscale) to differentiate between those who have seen relatively minor violent crime in comparison to those who have witnessed/ experienced serious violent crime. Likewise, adding age as a variable for those who have been witness to violence as a child in comparison to those who maybe have witnessed violent crime as an adult. Collectively, this information could be used as part of developing a way to achieve a cumulative score for participants on their preference towards violent media that may be a more reliable, robust and valid measure than was used in ch3 and ch4. It is therefore suggested that for future research, differentiations should be created between the extremes using additional self-report questions embedded within the demographic questionnaire to gather supplementary participant data. These future potential changes could provide a more valid method of group allocation as it would rely on several key factors rather than just specification of playing games/ watching films rated adult for violence or stating that they had been a witness/victim to a violent crime.

8.4 Future Development and Direction

It has been demonstrated that there is a need to invest in a stimuli catalogue that is current, relevant and has a sufficient wealth of categories that are not confounded with many hidden elements that could impact on results. For this, further investigation would be required to consider the content and formation of this process across all potential subcategories (as suggested in Chapter 7).

In addition, this research has determined that the standardisation of methodologies and data processing techniques must be made paramount. It has been recognised that this would require a field wide acknowledgement and adoption to develop more rigour, validity, reliability and cross-referencing between data sources. This would necessitate continued investigation into best practice applications.

This research has urged for a valid measure of aggression (ideally biometric) to be adopted where cognitive and behavioural differences would be identifiable on the scale prior to further surmised causality of the media influence.

EEG methodology was the preferred physiological method of measurement throughout the experimental chapters of the thesis. However, maybe this method could have been used in conjunction with alternative measures of physiological arousal, such as galvanic skin conductance with the aim of further disambiguating findings. Physiological measures such as heart rate/ blood pressure would be impractical methods using the current experimental design as changes across these methods need longer than the second per stimuli to be monitored effectively.

Finally, participation in the initial experiment (Ch 3.) was race and sexual orientation inclusive however, subsequent experiments were restricted to only include participants who were white, British and heterosexual. This research would need conducting across more population samples to be fully inclusive.

Appendices

Appendix A

Safety Regulations: The use of sinks in laboratories

ACTIVITY : Use of sinks in labs			Name : Kirstie Turner	
LOCATION : RB/17, RB/19b			Last updated : 7/10/17	
Hazard Identified	Details of Risk(s)	People at Risk	Measures in place to effectively manage risk(s)	Other comments
Electrocution	Use of electrical equipment after washing hands increases risk of electrocution. The sinks are required for washing hands after using electrode gel in Biopsychology studies.	Students, staff and participants in experiments.	Ensure that all hands are dry before using equipment. Paper towels to be provided for sessions that involve the use of sink.	

Water splashes onto electrical equipment	Fire hazard/electrocution	Students, staff and participants in experiments.	Ensure that electrical equipment is not too close and/or there is a physical barrier between sink and equipment.	
Slippery surface	If water has been splashed onto floor, then risk of slipping.	All people using the lab.	Wipe up spillages and advise people of slippery surface (e.g. 'caution – slippery surface' cone).	

Appendix B

Safety Regulations: The safe use of visual display units in the laboratory risk assessment form.

UNIVERSITY OF HUDDERSFIELD - GENERAL HEALTH AND SAFETY RISK ASSESSMENT FORM

(To be completed for intended and proposed activities)

Brief description of activity: VDU use in psychology laboratories		
Location: all psychology laboratories	Assessment by: Sarah Pearson	Assessment date: 14/11/14

SPECIFIC TASK/ASPECT OF ACTIVITY: Operation of display screen equipment						
Hazards identified	Risks to health and safety	People at risk	Measures to manage the risks	Action by:		
				Who	When	Completed
Computer and VDU operation	Working for prolonged periods without change of posture or sufficient break. Inappropriate layout, lack of awareness etc resulting in poor posture being adopted when using display	Staff and students working at display screen equipment.	Ensure staff and student awareness of the health and safety aspects of working at display screen equipment through training and/or information. The workstation and equipment			

	screen equipment.		is subject to the risk assessment process given within the University's specific policy for ensuring health and safety whilst working at display screen equipment.				

Appendix C

Safety Regulations: The safe use of dense array EEG system in biopsychological research risk assessment form.

UNIVERSITY OF HUDDERSFIELD - GENERAL HEALTH AND SAFETY RISK ASSESSMENT FORM

(To be completed for intended and proposed activities)

Brief description of activity: Use of dense array EEG system in		
Location: RB/19	Assessment by: Sarah Pearson	Assessment date: 29/06/14

SPECIFIC TASK/ASPECT OF ACTIVITY: Application of EEG sensor net						
				Action by:		
Hazards identified	Risks to health and safety	People at risk	Measures to manage the risks effectively	Who	When	Completed
Skin sensitivity towards electrolyte conducting medium (salt water and baby shampoo)	A small minority of people may be sensitive or allergic to the conducting medium	Participants tested using the EEG sensor net	Always use a hypo-allergenic baby shampoo Before beginning any study, experimenter should check that			

			the participant is not prone to skin allergies			

SPECIFIC TASK/ASPECT OF ACTIVITY: Disinfection of EEG sensor net						
				Action by:		
Hazards identified	Risks to health and safety	People at risk	Measures to manage the risks effectively	Wh o	Whe n	Complete d
Skin sensitivity towards disinfectio n solution	A small minority of people may be sensitive or allergic to the disinfectio n solution	Staff and student s cleaning the EEG sensor net	Always use the disinfectant specified by the manufacture r Wear protective gloves if necessary whilst in contact with the disinfection solution			

Appendix D

Safety Regulations: The safe use of anti-bacterial skin cleansing wipes when using physiological recording equipment risk assessment form.

UNIVERSITY OF HUDDERSFIELD - GENERAL HEALTH AND SAFETY RISK ASSESSMENT FORM

(To be completed for intended and proposed activities)

Brief description of activity: Use of anti-bacterial skin cleansing wipes when using physiological recording equipment		
Location: RB/19	Assessment by: Sarah Pearson	Assessment date: 8/12/14

SPECIFIC TASK/ASPECT OF ACTIVITY: Use of Skin cleansing wipes				
Hazards identified	Risks to health and safety	People at risk	Measures to manage the risks effectively	Comments
Skin sensitivity towards anti-bacterial skin cleansing wipes	A small minority of people may be sensitive or allergic to anti-bacterial skin cleansing wipes	Participants tested using physiological recording equipment	Always use hypo-allergenic wipes The experimenter should check that the participant is not prone to skin allergies before using.	

Appendix E

The demographic questionnaire example

Brain Activity and images

The aim of the following questions is to gather some information about your lifestyle choices and experiences. It will not be possible to identify you from the information given and you anonymity is assured. Please give the most appropriate answer for each question.

Sex

Male

Female

Age …………

Do you take part in sporting activities on a regular basis?

Yes

No

Which sport do you take part in the most?

……………………………………………………………………

Do you watch sporting activities on a regular basis?

Yes

No

Which sport do you enjoy watching the most?

……………………………………………………………………

Do you read books/ebooks on a regular basis?

Yes

No

What type of books/ebooks do you like to read, i.e. horror, comedy fiction?

……………………………………………………………………

Do you read graphic novels on a regular basis?

Yes

No

What type of graphic novels do you like to read, i.e. action or horror?

………………………………………………………………………

Do you watch films on a regular basis?

Yes

No

What type of films do you enjoy watching the most?

………………………………………………………………………

Have you ever witnessed a violent crime?

Yes

No

Have you ever been a victim of a violent crime?

Yes

No

Do you go to the theatre on a regular basis?

Yes

No

What type of plays do you enjoy watching the most?

………………………………………………………………………

Do you listen to music on a regular basis?

Yes

No

What type of music do you listen to the most?

………………………………………………………………………

How would you rate yourself as a videogame player?

Non-gamer

Recreational gamer

Casual gamer

Experienced gamer

Hardcore gamer

How many of hours a week do you spend gaming?

None

Less than 5

5-10

11-15

16-20

21-25

26-30

More than 30

What type of video game do you enjoy playing the most?

……………………………………………………………………

Appendix F

The Buss and Perry (1992) Aggression Questionnaire

	Strongly disagree Strongly agree
1. Some of my friends think I'm a hothead	1 2 3 4 5
2. If I have to resort to violence to protect my rights, I will	1 2 3 4 5
3. When people are especially nice I wonder what they want	1 2 3 4 5
4. I tell my friends openly when I disagree with them	1 2 3 4 5
5. I have become so mad that I have broken things	1 2 3 4 5
6. I can't help getting into arguments when people disagree with me	1 2 3 4 5
7. I wonder why sometimes I feel so bitter about things	1 2 3 4 5
8. Once in a while I cannot control the urge to strike another person	1 2 3 4 5
9. I am an even tempered person	1 2 3 4 5
10. I am suspicious of overly friendly strangers	

	1 2 3 4 5
11. I have threatened people I know	1 2 3 4 5
12. I flare up quickly, but get over it quickly	1 2 3 4 5
13. Given enough provocation, I may hit another person	1 2 3 4 5
14. When people annoy me I may tell them what I think of them	1 2 3 4 5
15. I am sometimes eaten up with jealousy	1 2 3 4 5
16. I can think of no good reason for ever hitting a person	1 2 3 4 5
17. At times I feel I have gotten a raw deal out of life	1 2 3 4 5
18. I have trouble controlling my temper	1 2 3 4 5
19. When frustrated, I let my irritation show	1 2 3 4 5
20. I sometimes feel that people are laughing at me behind my back	1 2 3 4 5
21. I often find myself disagreeing with people	1 2 3 4 5

22. If somebody hits me, I hit back	1 2 3 4 5
23. I sometimes feel like a powder keg ready to explode	1 2 3 4 5
24. Other people always seem to get the breaks	1 2 3 4 5
25. There are people who pushed me so far, we came to blows	1 2 3 4 5
26. I know that "friends" talk about me behind my back	1 2 3 4 5
27. My friends say I am somewhat argumentative	1 2 3 4 5
28. Sometimes I fly off the handle for no good reason	1 2 3 4 5
29. I get into fights a little more than the average person	1 2 3 4 5

Appendix G

Volunteer Information sheet example.

What Have You Seen ?

Investigating the effect of the media on neurological activation.

Researcher: Kirstie Turner

Contact Details:

Kirstie Turner	Main Supervisor: Dr Simon Goodson
Email:	Room
	Details Provided

I am a PhD student within the department of psychology at the University of Huddersfield investigating how the brain responds to emotional images and how that relates to personality and life experiences. This research conforms to ethical guidelines published by the British Psychological Society, which is the governing body for all psychological research conducted in the United Kingdom. These guidelines include principles such as obtaining your informed consent prior to beginning any research, notifying you of your right to withdraw, and the protection of your anonymity. This sheet will hopefully provide you with enough information about the study to allow you to make an informed decision about your participation. However, if you have any further questions, or would like to discuss anything with us please let me know.

I am investigating the early response of the brain to differing emotive images and the relationship between this response and life experience. Due to the nature of this study, you will not be identifiable from any part of the research, published or unpublished.

You will be required to complete online consent forms and questionnaires prior to the experiment. During the experiment, I attach an EEG net to your head; this may result in some minor discomfort until it is positioned correctly however, it should not be painful. The EEG net is soaked in salt water and baby shampoo and in most cases people have no adverse allergic reaction to these chemicals. If you feel that the net is extremely unpleasant please let me know and I will remove it immediately.

The experiment requires you to passively watch a set of images on a computer screen whilst I record your brain activity. The images will contain some very graphic violent, gory and erotic scenes. If you do not want to view these images please let me know and you do not have to take part in the study. If you have any physical or medical conditions that would prevent you taking part in this research or, you are taking any medication such as antipsychotic or antiepileptic drugs please let me know and you do not have to take part in the study.

As has been mentioned, you have the right to withdraw from this research. However, after the data has gone into the analysing stage, there will be no way of identifying your data due to the EEG software used during analysis. Therefore, I will not be able to remove your data after this point. Should you require any further information on this matter please contact me and I will be happy to discuss any concerns you may have.

Thank you for volunteering to take part in this scientific research, I am immensely grateful for your time. If you have any questions, please do ask. Please keep this sheet in case you think of anything in the future that you would like to discuss about the study.

Your participant number is:

Appendix H

Participant consent form example

Consent Form

Study title:

Thank you very much for volunteering to take part in the research project. The purpose of this form is to make sure that you are happy to take part in the experiment and that you know exactly what is involved.

Have you had the opportunity to ask questions and discuss the study?	YES/NO
If you have asked questions have you had satisfactory answers to your questions?	YES/NO/NA
Do you understand that you are free to end the experiment at any time?	YES/NO
Do you understand that you are free to choose not to answer a question without having to give a reason why?	YES/NO
Have you had the opportunity to inform the experimenter about any pre-existing conditions that you may have that could prevent you from taking part in this research?	YES/NO
Have you been informed that this study complies with the ethical regulations published by the British Psychological Society?	YES/NO
Do you grant permission for the data collected in the experiment to be used in reports of the research on the understanding that your anonymity will be maintained?	YES/NO
Do you agree to take part in this study?	YES/NO

PLEASE PRINT YOUR NAME CLEARLY

....

SIGNED

....

DATE

……………..........................

Appendix I

Overview of Manufacturers Guidelines (EGI) for dense array net care

Rinsing Electrolyte out of the net

1. Carefully remove the Hydrocel Geodesic Sensor net from the participants head
2. Carefully turn net inside out
3. Fill rinse bucket with clean warm water
4. Immerse sensors and net in the water
5. Gently agitate the net for 10 to 20 seconds keeping the water moving through net and sponges. Ensure caution not to damage the wires by pinching too hard.
6. Rinse
7. Repeat steps 3-6 for another 3 times
8. Gentle pat the net dry in a clean towel.

Disinfecting the net

1. Prepare 2 litres of disinfectant (Control III)
2. Immerse net in disinfectant water, ensuring all sensors and sponges are submerged and plunge the net repeatedly for first 2-3 mins, without submerging hands.
3. Set timer for 10 mins
4. Remove after 10 minutes- don’t not leave net in disinfectant for more than 10 mins.

Rinsing the Disinfectant out of the net

1. Rinse the disinfectant out of the net by following steps 3-7 from “Rinsing Electrolyte out of the net” procedure.

Appendix J

Participant debrief form example

Brain activity and images

Volunteer Debriefing Sheet

Researcher: Kirstie Turner

Contact Details:

Kirstie Turner

Thank you for participating in this research project. The aim of the study was to investigate how lifestyle choices and life experience, including personality, effect the way that the brain responds to emotional images. The EEG net was attached to a piece of equipment that measured your brain activity. The questionnaires are validated scales that measure aggression and personality.

Due to the nature of the study it is not possible to give you feedback on any of the measures taken, as no personal information was recorded that could link you to your results. This is a necessary step to maintain your anonymity and to comply with the regulations published by the British Psychological Society.

If you have any questions about the study, either now or at a later time, please do not hesitate in contacting us using the above details. If you have any concerns about the research here are some website that you may find informative:

The British Psychological Society (Ethics and Code of Conduct)

www.bps.org.uk/the-society/ethics-rules-charter-code-of-conduct/code-of-conduct/code-of-conduct_home.cfm

Gamblers Anonymous

www.gamblersanonymous.org

Gambling Therapy Helpline

www.gamblingtherapy.org

Video Game Overuse

www.mediafamily.org/facts/facts_gameaddiction.shtml

Appendix K

Chapter 5 - Section 1: Trait Aggression (Cut Off at '81') Additional Data

Table of inferential statistics for Chapter 5.5.1 results. One-way independent groups ANOVA (two-tailed) results for mean ERP amplitude for males and females scoring high or low on the Buss and Perry (1992) Aggression Questionnaire, across the electrode site and epoch, in relation to image category. The results below relate to the analysis of a high total aggression score of 81 and above.

High Agg Fems, High Agg Males, Low Agg Fems and Low Agg Males.					
Image category & Site	100	200	300	ELPP	LLPP
Fz					
Neutral	F(3,77) =2.19 p=0.1	F(3,77) =3.15 p=0.03	F(3,77) =0.35 p=0.79	F(3,77) =0.3 p=0.82	F(3,77) =0.82 p=0.49
Violent	F(3,77) =0.53 p=0.66	F(3,77) =3.02 p=0.04	F(3,77) =0.82 p=0.49	F(3,77) =1.39 p=0.25	F(3,77) =2.01 p=0.12
Erotic	F(3,77) =0.37 p=0.77	F(3,77) =0.81 p=0.49	F(3,77) =0.09 p=0.97	F(3,77) =0.47 p=0.7	F(3,77) =0.63 p=0.6
Disgust	F(3,77) =2.88 p=0.04	F(3,77) =3.84 p=0.01	F(3,77) =0.78 p=0.51	F(3,77) =1.26 p=0.3	F(3,77) =2.48 p=0.07
Fcz					

Neutral	F(3,77) =1.61 p=0.19	F(3,77) =2.29 p=0.09	F(3,77) =0.36 p=0.78	F(3,77) =0.5 p=0.68	F(3,77) =0.98 p=0.41
Violent	F(3,77) =1.16 p=0.33	F(3,77) =4.01 p=0.01	F(3,77) =1.21 p=0.31	F(3,77) =1.52 p=0.22	F(3,77) =1.63 p=0.19
Erotic	F(3,77) =0.34 p=0.79	F(3,77) =1.73 p=0.17	F(3,77) =0.34 p=0.8	F(3,77) =0.86 p=0.46	F(3,77) =1.3 p=0.28
Disgust	F(3,77) =2.15 p=0.1	F(3,77) =3.26 p=0.03	F(3,77) =1.39 p=0.25	F(3,77) =2.15 p=0.1	F(3,77) =2.89 p=0.04
Cz					
Neutral	F(3,77) =4.3 p=0.01	F(3,77) =3.8 p=0.01	F(3,77) =1.32 p=0.28	F(3,77) =0.77 p=0.52	F(3,77) =0.79 p=0.5
Violent	F(3,77) =2.41 p=0.07	F(3,77) =6.27 p=0	F(3,77) =3.91 p=0.01	F(3,77) =2.61 p=0.06	F(3,77) =3.2 p=0.03
Erotic	F(3,77) =3.68 p=0.02	F(3,77) =2.77 p=0.05	F(3,77) =0.8 p=0.5	F(3,77) =3.09 p=0.03	F(3,77) =4.07 p=0.01
Disgust	F(3,77) =0.61 p=0.61	F(3,77) =1.96 p=0.13	F(3,77) =0.8 p=0.5	F(3,77) =2.8 p=0.05	F(3,77) =1.75 p=0.16
Pz					
Neutral	F(3,77) =3.29 p=0.03	F(3,77) =4.67 p=0	F(3,77) =5.06 p=0	F(3,77) =3 p=0.04	F(3,77) =3.06 p=0.03
Violent	F(3,77) =4.64 p=0.01	F(3,77) =9.78 p=0	F(3,77) =6.82 p=0	F(3,77) =2.68 p=0.05	F(3,77) =4.02 p=0.01

Erotic	F(3,77) =4.18 p=0.01	F(3,77) =6.22 p=0	F(3,77) =4.09 p=0.01	F(3,77) =3.22 p=0.03	F(3,77) =4.88 p=0
Disgust	F(3,77) =0.1 p=0.96	F(3,77) =1.91 p=0.14	F(3,77) =0.78 p=0.51	F(3,77) =0.16 p=0.92	F(3,77) =0.79 p=0.5

*Highlighted values show significant results

Appendix L

Chapter 5 - Section 1: Trait Aggression (Cut Off at '81') Post Hoc Tests

Post Hoc Tests

Table of Bonferroni Post Hoc Test results to show which groups differ for the ANOVAs (Appendix K).

	High Agg Female						High Agg Males					
Region and Image	Low Agg Female		Low Agg Male		High Agg Male		Low Agg Female		Low Agg Male		High Agg Female	
	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P
100ms												
Fz												
Neutral	0.04	1.00	-0.75	1.00	-1.57	0.50	1.62	0.12	0.83	1.00	1.57	0.50
Violent	-0.59	1.00	-0.80	1.00	-0.76	1.00	0.17	1.00	-0.04	1.00	0.76	1.00
Erotic	0.57	1.00	0.92	1.00	0.94	1.00	-0.37	1.00	-0.02	1.00	-0.94	1.00
Disgust	0.51	1.00	-0.37	1.00	-0.99	1.00	1.50	0.05	0.62	1.00	0.99	1.00
Fcz												
Neutral	-0.18	1.00	-0.69	1.00	-1.26	0.54	1.08	0.35	0.57	1.00	1.26	0.54
Violent	-0.91	0.61	-0.95	0.63	-1.09	0.58	0.17	1.00	0.14	1.00	1.09	0.58

Erotic	-0.01	1.00	0.51	1.00	0.06	1.00	-0.07	1.00	0.45	1.00	-0.06	1.00
Disgust	-0.03	1.00	-0.51	1.00	-1.24	0.39	1.21	0.12	0.74	1.00	1.24	0.39
Cz												
Neutral	0.15	1.00	1.26	0.10	1.01	0.50	-0.86	0.32	0.25	1.00	-1.01	0.50
Violent	0.20	1.00	1.11	0.28	0.35	1.00	-0.15	1.00	0.76	0.77	-0.35	1.00
Erotic	-0.19	1.00	0.79	0.44	0.28	1.00	-0.46	1.00	0.51	1.00	-0.28	1.00
Disgust	0.33	1.00	0.54	1.00	0.07	1.00	0.26	1.00	0.47	1.00	-0.07	1.00
Pz												
Neutral	0.33	1.00	2.02	0.13	0.88	1.00	-0.55	1.00	1.14	0.88	-0.88	1.00
Violent	0.45	1.00	2.14	0.03	0.85	1.00	-0.40	1.00	1.30	0.34	-0.85	1.00
Erotic	-1.06	0.81	0.63	1.00	-0.93	1.00	-0.13	1.00	1.56	0.13	0.93	1.00
Disgust	-0.14	1.00	0.12	1.00	0.20	1.00	-0.34	1.00	-0.08	1.00	-0.20	1.00
200ms												
Fz												
Neutral	0.04	1.00	-0.80	1.00	-3.23	0.16	3.27	0.02	2.43	0.24	3.23	0.16
Violent	-0.39	1.00	0.03	1.00	-3.39	0.17	3.00	0.07	3.42	0.04	3.39	0.17
Erotic	0.74	1.00	0.94	1.00	-1.20	1.00	1.93	1.00	2.13	0.94	1.20	1.00
Disgust	0.89	1.00	0.08	1.00	-2.75	0.33	3.63	0.01	2.82	0.09	2.75	0.33
Fcz												
Neutral	-0.20	1.00	-0.48	1.00	-2.54	0.26	2.33	0.09	2.05	0.26	2.54	0.26

Violent	-0.77	1.00	-0.27	1.00	-3.67	0.04	2.90	0.03	3.40	0.01	3.67	0.04
Erotic	0.32	1.00	0.56	1.00	-2.07	1.00	2.39	0.26	2.63	0.22	2.07	1.00
Disgust	0.39	1.00	-0.05	1.00	-2.70	0.26	3.09	0.02	2.65	0.09	2.70	0.26
Cz												
Neutral	0.08	1.00	2.17	0.16	1.24	1.00	-1.16	0.97	0.92	1.00	-1.24	1.00
Violent	0.69	1.00	3.58	0.01	0.70	1.00	-0.01	1.00	2.88	0.03	-0.70	1.00
Erotic	0.00	1.00	0.90	1.00	-1.49	0.91	1.49	0.37	2.39325*	0.03	1.49	0.91
Disgust	0.89	1.00	1.95	0.31	0.24	1.00	0.65	1.00	1.71	0.36	-0.24	1.00
Pz												
Neutral	0.29	1.00	3.05	0.06	1.61	1.00	-1.32	1.00	1.44	1.00	-1.61	1.00
Violent	0.64	1.00	4.33	0.00	2.71	0.19	-2.07	0.18	1.62	0.65	-2.71	0.19
Erotic	-1.25	1.00	1.46	0.79	-1.09	1.00	-0.16	1.00	2.55	0.03	1.09	1.00
Disgust	0.48	1.00	2.08	0.58	2.04	0.88	-1.56	0.86	0.05	1.00	-2.04	0.88
300ms												
Fz												
Neutral	0.07	1.00	-0.33	1.00	-1.06	1.00	1.13	1.00	0.73	1.00	1.06	1.00
Violent	-1.53	1.00	-0.18	1.00	-2.26	1.00	0.73	1.00	2.08	1.00	2.26	1.00
Erotic	-0.57	1.00	-0.93	1.00	-0.83	1.00	0.26	1.00	-0.10	1.00	0.83	1.00
Disgust	-1.54	1.00	-1.77	1.00	-2.31	0.87	0.78	1.00	0.55	1.00	2.31	0.87
Fcz												

Neutral	-0.32	1.00	-0.41	1.00	-1.20	1.00	0.88	1.00	0.79	1.00	1.20	1.00
Violent	-1.91	1.00	-0.87	1.00	-3.01	0.62	1.10	1.00	2.14	0.90	3.01	0.62
Erotic	-0.82	1.00	-1.03	1.00	-1.72	1.00	0.90	1.00	0.69	1.00	1.72	1.00
Disgust	-1.60	1.00	-1.78	0.93	-2.82	0.28	1.22	1.00	1.04	1.00	2.82	0.28
Cz												
Neutral	0.39	1.00	1.55	0.80	0.26	1.00	0.12	1.00	1.29	1.00	-0.26	1.00
Violent	1.18	1.00	3.68	0.03	1.46	1.00	-0.29	1.00	2.21	0.36	-1.46	1.00
Erotic	-0.44	1.00	0.26	1.00	-1.11	1.00	0.67	1.00	1.37	0.89	1.11	1.00
Disgust	0.32	1.00	1.30	1.00	0.42	1.00	-0.11	1.00	0.88	1.00	-0.42	1.00
Pz												
Neutral	0.09	1.00	2.26	0.14	-0.65	1.00	0.74	1.00	2.92	0.01	0.65	1.00
Violent	1.41	1.00	4.64	0.00	2.05	0.85	-0.64	1.00	2.59	0.14	-2.05	0.85
Erotic	-1.15	1.00	0.93	1.00	-2.59	0.35	1.44	0.99	3.52	0.01	2.59	0.35
Disgust	0.16	1.00	1.47	1.00	0.21	1.00	-0.05	1.00	1.26	1.00	-0.21	1.00
ELPP												
Fz												
Neutral	-1.02	1.00	-0.81	1.00	-1.30	1.00	0.27	1.00	0.49	1.00	1.30	1.00
Violent	-1.83	1.00	0.22	1.00	-0.45	1.00	-1.38	1.00	0.67	1.00	0.45	1.00
Erotic	-2.05	1.00	-0.76	1.00	-0.15	1.00	-1.90	1.00	-0.61	1.00	0.15	1.00
Disgust	-2.38	0.79	-0.75	1.00	-2.25	1.00	-0.13	1.00	1.50	1.00	2.25	1.00

Fcz												
Neutral	-1.22	1.00	-0.79	1.00	-1.15	1.00	-0.07	1.00	0.36	1.00	1.15	1.00
Violent	-2.12	0.69	-0.39	1.00	-1.16	1.00	-0.96	1.00	0.78	1.00	1.16	1.00
Erotic	-2.49	1.00	-0.86	1.00	-0.95	1.00	-1.54	1.00	0.09	1.00	0.95	1.00
Disgust	-2.36	0.44	-0.63	1.00	-2.66	0.52	0.29	1.00	2.02	0.63	2.66	0.52
Cz												
Neutral	-0.51	1.00	0.34	1.00	-0.44	1.00	-0.07	1.00	0.78	1.00	0.44	1.00
Violent	1.21	1.00	2.88	0.09	2.08	0.68	-0.87	1.00	0.80	1.00	-2.08	0.68
Erotic	-2.35	0.14	-0.55	1.00	-0.88	1.00	-1.47	0.65	0.33	1.00	0.88	1.00
Disgust	-1.14	1.00	0.53	1.00	0.76	1.00	-1.89	0.17	-0.22	1.00	-0.76	1.00
Pz												
Neutral	0.15	1.00	1.24	1.00	-1.25	1.00	1.40	0.49	2.49	0.03	1.25	1.00
Violent	2.43	0.18	3.09	0.06	1.49	1.00	0.93	1.00	1.60	0.79	-1.49	1.00
Erotic	-1.48	1.00	-0.85	1.00	-3.93	0.04	2.45	0.16	3.07	0.06	3.92570*	0.04
Disgust	0.01	1.00	0.21	1.00	0.72	1.00	-0.71	1.00	-0.50	1.00	-0.72	1.00
LLPP												
Fz												
Neutral	-1.67	0.79	-1.32	1.00	-1.65	1.00	-0.02	1.00	0.33	1.00	1.65	1.00
Violent	-1.57	1.00	0.36	1.00	0.11	1.00	-1.69	0.74	0.25	1.00	-0.11	1.00
Erotic	-2.72	1.00	-1.88	1.00	-2.27	1.00	-0.45	1.00	0.39	1.00	2.27	1.00

Disgust	-3.34	0.08	-1.90	1.00	-3.14	0.29	-0.20	1.00	1.24	1.00	3.14	0.29
Fcz												
Neutral	-1.54	0.58	-1.08	1.00	-1.31	1.00	-0.23	1.00	0.23	1.00	1.31	1.00
Violent	-1.63	0.70	-0.24	1.00	-0.57	1.00	-1.05	1.00	0.34	1.00	0.57	1.00
Erotic	-3.04	0.41	-1.79	1.00	-2.80	0.91	-0.24	1.00	1.01	1.00	2.80	0.91
Disgust	-2.76	0.07	-1.57	0.97	-2.92	0.13	0.16	1.00	1.35	1.00	2.92	0.13
Cz												
Neutral	-0.45	1.00	-0.01	1.00	-0.79	1.00	0.34	1.00	0.78	1.00	0.79	1.00
Violent	2.03	0.18	2.98	0.02	2.19	0.28	-0.16	1.00	0.79	1.00	-2.19	0.28
Erotic	-2.49	0.01	-1.19	0.93	-2.04	0.19	-0.45	1.00	0.85	1.00	2.04	0.19
Disgust	-0.85	1.00	-0.12	1.00	0.55	1.00	-1.40	0.23	-0.67	1.00	-0.55	1.00
Pz												
Neutral	0.43	1.00	1.04	1.00	-1.12	1.00	1.55	0.16	2.17	0.02	1.12	1.00
Violent	2.91	0.02	3.30	0.01	2.00	0.49	0.91	1.00	1.31	0.94	-2.00	0.49
Erotic	-1.70	0.39	-1.07	1.00	-3.75	0.00	2.05	0.08	2.67	0.02	3.75	0.00
Disgust	0.04	1.00	0.32	1.00	1.38	1.00	-1.35	0.85	-1.06	1.00	-1.38	1.00
	Low Agg Female						Low Agg Males					
Region and Image	Low Agg Male		High Agg Male		High Agg Female		Low Agg Female		High Agg Male		High Agg Female	

	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P
100ms												
Fz												
Neutral	-0.79	0.93	-1.62	0.12	-0.04	1.00	0.79	0.93	-0.83	1.00	0.75	1.00
Violent	-0.20	1.00	-0.17	1.00	0.59	1.00	0.20	1.00	0.04	1.00	0.80	1.00
Erotic	0.35	1.00	0.37	1.00	-0.57	1.00	-0.35	1.00	0.02	1.00	-0.92	1.00
Disgust	-0.88	0.32	-1.50	0.05	-0.51	1.00	0.88	0.32	-0.62	1.00	0.37	1.00
Fcz												
Neutral	-0.51	1.00	-1.08	0.35	0.18	1.00	0.51	1.00	-0.57	1.00	0.69	1.00
Violent	-0.03	1.00	-0.17	1.00	0.91	0.61	0.03	1.00	-0.14	1.00	0.95	0.63
Erotic	0.52	1.00	0.07	1.00	0.01	1.00	-0.52	1.00	-0.45	1.00	-0.51	1.00
Disgust	-0.47	1.00	-1.21	0.12	0.03	1.00	0.47	1.00	-0.74	1.00	0.51	1.00
Cz												
Neutral	1.11	0.01	0.86	0.32	-0.15	1.00	-1.11	0.01	-0.25	1.00	-1.26	0.10
Violent	0.91	0.11	0.15	1.00	-0.20	1.00	-0.91	0.11	-0.76	0.77	-1.11	0.28
Erotic	.98	0.01	0.46	1.00	0.19	1.00	-0.97	0.01	-0.51	1.00	-0.79	0.44
Disgust	0.21	1.00	-0.26	1.00	-0.33	1.00	-0.21	1.00	-0.47	1.00	-0.54	1.00
Pz												
Neutral	1.69	0.03	0.55	1.00	-0.33	1.00	-1.69	0.03	-1.14	0.88	-2.02	0.13

Violent	1.69	0.01	0.40	1.00	-0.45	1.00	-1.69	0.01	-1.30	0.34	-2.14	0.03
Erotic	1.69	0.01	0.13	1.00	1.06	0.81	-1.69	0.01	-1.56	0.13	-0.63	1.00
Disgust	0.26	1.00	0.34	1.00	0.14	1.00	-0.26	1.00	0.08	1.00	-0.12	1.00
200ms												
Fz												
Neutral	-0.84	1.00	-3.27	0.02	-0.04	1.00	0.84	1.00	-2.43	0.24	0.80	1.00
Violent	0.42	1.00	-3.00	0.07	0.39	1.00	-0.42	1.00	-3.42	0.04	-0.03	1.00
Erotic	0.20	1.00	-1.93	1.00	-0.74	1.00	-0.20	1.00	-2.13	0.94	-0.94	1.00
Disgust	-0.81	1.00	-3.63	0.01	-0.89	1.00	0.81	1.00	-2.82	0.09	-0.08	1.00
Fcz												
Neutral	-0.28	1.00	-2.33	0.09	0.20	1.00	0.28	1.00	-2.05	0.26	0.48	1.00
Violent	0.50	1.00	-2.90	0.03	0.77	1.00	-0.50	1.00	-3.40	0.01	0.27	1.00
Erotic	0.23	1.00	-2.39	0.26	-0.32	1.00	-0.23	1.00	-2.63	0.22	-0.56	1.00
Disgust	-0.43	1.00	-3.09	0.02	-0.39	1.00	0.43	1.00	-2.65	0.09	0.05	1.00
Cz												
Neutral	2.08	0.01	1.16	0.97	-0.08	1.00	-2.08	0.01	-0.92	1.00	-2.17	0.16
Violent	2.89	0.00	0.01	1.00	-0.69	1.00	-2.89	0.00	-2.88	0.03	-3.58	0.01
Erotic	0.90	0.94	-1.49	0.37	0.00	1.00	-0.90	0.94	-2.39	0.03	-0.90	1.00
Disgust	1.06	0.73	-0.65	1.00	-0.89	1.00	-1.06	0.73	-1.71	0.36	-1.95	0.31
Pz												

Neutral	2.76	0.01	1.32	1.00	-0.29	1.00	-2.76	0.01	-1.44	1.00	-3.05	0.06
Violent	3.69	0.00	2.07	0.18	-0.64	1.00	-3.69	0.00	-1.62	0.65	-4.33	0.00
Erotic	2.71	0.00	0.16	1.00	1.25	1.00	-2.71	0.00	-2.55	0.03	-1.46	0.79
Disgust	1.61	0.38	1.56	0.86	-0.48	1.00	-1.61	0.38	-0.05	1.00	-2.08	0.58
300ms												
Fz												
Neutral	-0.40	1.00	-1.13	1.00	-0.07	1.00	0.40	1.00	-0.73	1.00	0.33	1.00
Violent	1.35	1.00	-0.73	1.00	1.53	1.00	-1.35	1.00	-2.08	1.00	0.18	1.00
Erotic	-0.36	1.00	-0.26	1.00	0.57	1.00	0.36	1.00	0.10	1.00	0.93	1.00
Disgust	-0.23	1.00	-0.78	1.00	1.54	1.00	0.23	1.00	-0.55	1.00	1.77	1.00
Fcz												
Neutral	-0.09	1.00	-0.88	1.00	0.32	1.00	0.09	1.00	-0.79	1.00	0.41	1.00
Violent	1.04	1.00	-1.10	1.00	1.91	1.00	-1.04	1.00	-2.14	0.90	0.87	1.00
Erotic	-0.21	1.00	-0.90	1.00	0.82	1.00	0.21	1.00	-0.69	1.00	1.03	1.00
Disgust	-0.18	1.00	-1.22	1.00	1.60	1.00	0.18	1.00	-1.04	1.00	1.78	0.93
Cz												
Neutral	1.16	0.60	-0.12	1.00	-0.39	1.00	-1.16	0.60	-1.29	1.00	-1.55	0.80
Violent	2.50	0.03	0.29	1.00	-1.18	1.00	-2.50	0.03	-2.21	0.36	-3.68	0.03
Erotic	0.70	1.00	-0.67	1.00	0.44	1.00	-0.70	1.00	-1.37	0.89	-0.26	1.00
Disgust	0.98	1.00	0.11	1.00	-0.32	1.00	-0.98	1.00	-0.88	1.00	-1.30	1.00

Pz											
Neutral	2.17	0.01	-0.74	1.00	-0.09	1.00	-2.17	0.01	-2.92	0.01	-2.26	0.14
Violent	3.23	0.00	0.64	1.00	-1.41	1.00	-3.23	0.00	-2.59	0.14	-4.64	0.00
Erotic	2.08	0.08	-1.44	0.99	1.15	1.00	-2.08	0.08	-3.52	0.01	-0.93	1.00
Disgust	1.31	1.00	0.05	1.00	-0.16	1.00	-1.31	1.00	-1.26	1.00	-1.47	1.00
ELPP												
Fz												
Neutral	0.22	1.00	-0.27	1.00	1.02	1.00	-0.22	1.00	-0.49	1.00	0.81	1.00
Violent	2.05	0.38	1.38	1.00	1.83	1.00	-2.05	0.38	-0.67	1.00	-0.22	1.00
Erotic	1.29	1.00	1.90	1.00	2.05	1.00	-1.29	1.00	0.61	1.00	0.76	1.00
Disgust	1.63	0.91	0.13	1.00	2.38	0.79	-1.63	0.91	-1.50	1.00	0.75	1.00
Fcz												
Neutral	0.43	1.00	0.07	1.00	1.22	1.00	-0.43	1.00	-0.36	1.00	0.79	1.00
Violent	1.74	0.44	0.96	1.00	2.12	0.69	-1.74	0.44	-0.78	1.00	0.39	1.00
Erotic	1.63	1.00	1.54	1.00	2.49	1.00	-1.63	1.00	-0.09	1.00	0.86	1.00
Disgust	1.73	0.41	-0.29	1.00	2.36	0.44	-1.73	0.41	-2.02	0.63	0.63	1.00
Cz												
Neutral	0.85	0.93	0.07	1.00	0.51	1.00	-0.85	0.93	-0.78	1.00	-0.34	1.00
Violent	1.67	0.24	0.87	1.00	-1.21	1.00	-1.67	0.24	-0.80	1.00	-2.88	0.09
Erotic	1.80	0.10	1.47	0.65	2.35	0.14	-1.80	0.10	-0.33	1.00	0.55	1.00

Disgust	1.67	0.10	1.89	0.17	1.14	1.00	-1.67	0.10	0.22	1.00	-0.53	1.00
Pz												
Neutral	1.09	0.55	-1.40	0.49	-0.15	1.00	-1.09	0.55	-2.49	0.03	-1.24	1.00
Violent	0.66	1.00	-0.93	1.00	-2.43	0.18	-0.66	1.00	-1.60	0.79	-3.09	0.06
Erotic	0.63	1.00	-2.45	0.16	1.48	1.00	-0.63	1.00	-3.07	0.06	0.85	1.00
Disgust	0.20	1.00	0.71	1.00	-0.01	1.00	-0.20	1.00	0.50	1.00	-0.21	1.00
LLPP												
Fz												
Neutral	0.35	1.00	0.02	1.00	1.67	0.79	-0.35	1.00	-0.33	1.00	1.32	1.00
Violent	1.93	0.18	1.69	0.74	1.57	1.00	-1.93	0.18	-0.25	1.00	-0.36	1.00
Erotic	0.84	1.00	0.45	1.00	2.72	1.00	-0.84	1.00	-0.39	1.00	1.88	1.00
Disgust	1.44	0.82	0.20	1.00	3.34	0.08	-1.44	0.82	-1.24	1.00	1.90	1.00
Fcz												
Neutral	0.46	1.00	0.23	1.00	1.54	0.58	-0.46	1.00	-0.23	1.00	1.08	1.00
Violent	1.39	0.38	1.05	1.00	1.63	0.70	-1.39	0.38	-0.34	1.00	0.24	1.00
Erotic	1.25	1.00	0.24	1.00	3.04	0.41	-1.25	1.00	-1.01	1.00	1.79	1.00
Disgust	1.19	0.73	-0.16	1.00	2.76	0.07	-1.19	0.73	-1.35	1.00	1.57	0.97
Cz												
Neutral	0.44	1.00	-0.34	1.00	0.45	1.00	-0.44	1.00	-0.78	1.00	0.01	1.00
Violent	0.95	0.93	0.16	1.00	-2.03	0.18	-0.95	0.93	-0.79	1.00	-2.98	0.02

Erotic	1.30	0.15	0.45	1.00	2.49	0.01	-1.30	0.15	-0.85	1.00	1.19	0.93
Disgust	0.72	1.00	1.40	0.23	0.85	1.00	-0.72	1.00	0.67	1.00	0.12	1.00
Pz												
Neutral	0.61	1.00	-1.55	0.16	-0.43	1.00	-0.61	1.00	-2.17	0.02	-1.04	1.00
Violent	0.39	1.00	-0.91	1.00	-2.91	0.02	-0.39	1.00	-1.31	0.94	-3.30	0.01
Erotic	0.63	1.00	-2.05	0.08	1.70	0.39	-0.63	1.00	-2.67	0.02	1.07	1.00
Disgust	0.28	1.00	1.35	0.85	-0.04	1.00	-0.28	1.00	1.06	1.00	-0.32	1.00

Appendix M

Chapter 5 - Section 2: Trait Aggression (Data Median) Additional Data

Table of inferential statistics for Chapter 5.5.2 results. One-way independent groups ANOVA (two-tailed) results for mean ERP amplitude for males and females scoring high or low on the Buss and Perry (1992) Aggression Questionnaire, across the electrode site and epoch, in relation to image category. The results below relate to the analysis of a high and low total aggression score that was defined by the data median of 73.

High Agg Fems, High Agg Males, Low Agg Fems and Low Agg Males.					
Image category & Site	100	200	300	ELPP	LLPP
Fz					
Neutral	$F(3,77) = 2.69$ $p=0.05$	$F(3,77) = 1.6$ $p=0.2$	$F(3,77) = 0.56$ $p=0.64$	$F(3,77) = 1.31$ $p=0.28$	$F(3,77) = 1.21$ $p=0.31$
Violent	$F(3,77) = 0.53$ $p=0.66$	$F(3,77) = 1.19$ $p=0.32$	$F(3,77) = 0.31$ $p=0.82$	$F(3,77) = 1.27$ $p=0.29$	$F(3,77) = 1.76$ $p=0.16$
Erotic	$F(3,77) = 1.5$ $p=0.22$	$F(3,77) = 0.68$ $p=0.57$	$F(3,77) = 0.35$ $p=0.79$	$F(3,77) = 0.96$ $p=0.41$	$F(3,77) = 0.63$ $p=0.6$
Disgust	$F(3,77) = 4.31$ $p=0.01$	$F(3,77) = 1.68$ $p=0.18$	$F(3,77) = 0.67$ $p=0.58$	$F(3,77) = 1.3$ $p=0.28$	$F(3,77) = 0.68$ $p=0.57$
Fcz					

Neutral	F(3,77) =2.67 p=0.05	F(3,77) =0.85 p=0.47	F(3,77) =0.43 p=0.73	F(3,77) =1.32 p=0.28	F(3,77) =1.06 p=0.37
Violent	F(3,77) =1.36 p=0.26	F(3,77) =1.44 p=0.24	F(3,77) =0.21 p=0.89	F(3,77) =0.83 p=0.48	F(3,77) =1.11 p=0.35
Erotic	F(3,77) =1.44 p=0.24	F(3,77) =1.42 p=0.24	F(3,77) =0.26 p=0.85	F(3,77) =0.95 p=0.42	F(3,77) =0.79 p=0.5
Disgust	F(3,77) =3.09 p=0.03	F(3,77) =1.22 p=0.31	F(3,77) =0.52 p=0.67	F(3,77) =0.85 p=0.47	F(3,77) =0.35 p=0.79
Cz					
Neutral	F(3,77) =4.22 p=0.01	F(3,77) =5.04 p=0	F(3,77) =1.59 p=0.2	F(3,77) =2.02 p=0.12	F(3,77) =1.03 p=0.38
Violent	F(3,77) =2.52 p=0.06	F(3,77) =3.1 p=0.03	F(3,77) =2.28 p=0.09	F(3,77) =2.37 p=0.08	F(3,77) =1.76 p=0.16
Erotic	F(3,77) =3.22 p=0.03	F(3,77) =0.6 p=0.62	F(3,77) =0.67 p=0.57	F(3,77) =3.49 p=0.02	F(3,77) =2.42 p=0.07
Disgust	F(3,77) =0.17 p=0.92	F(3,77) =0.58 p=0.63	F(3,77) =0.58 p=0.63	F(3,77) =2.76 p=0.05	F(3,77) =1 p=0.4
Pz					
Neutral	F(3,77) =2.81 p=0.05	F(3,77) =4.08 p=0.01	F(3,77) =1.52 p=0.22	F(3,77) =0.44 p=0.72	F(3,77) =0.44 p=0.72
Violent	F(3,77) =3.63 p=0.02	F(3,77) =9.57 p=0	F(3,77) =6.58 p=0	F(3,77) =4.02 p=0.01	F(3,77) =2.68 p=0.05

Erotic	$F(3,77) = 3.22$ $p = 0.03$	$F(3,77) = 3.43$ $p = 0.02$	$F(3,77) = 2.98$ $p = 0.04$	$F(3,77) = 7.63$ $p = 0$	$F(3,77) = 6.92$ $p = 0$
Disgust	$F(3,77) = 0.47$ $p = 0.71$	$F(3,77) = 3.17$ $p = 0.03$	$F(3,77) = 1.48$ $p = 0.23$	$F(3,77) = 1.2$ $p = 0.32$	$F(3,77) = 0.93$ $p = 0.43$

*Highlighted values show significant results

Appendix N

Chapter 5 - Section 2: Trait Aggression (Data Median) Post Hoc Tests

Post Hoc Tests

Table of Bonferroni Post Hoc Test results to show which groups differ for the ANOVAs (Appendix M).

	High Agg Female						High Agg Males					
Region and Image	Low Agg Female		Low Agg Male		High Agg Male		Low Agg Female		Low Agg Male		High Agg Female	
	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P
100ms												
Fz												
Neutral	0.13	1.00	-0.17	1.00	-1.36	0.22	1.49	0.07	1.20	0.64	1.36	0.22
Violent	-0.15	1.00	-0.03	1.00	-0.58	1.00	0.43	1.00	0.55	1.00	0.58	1.00
Erotic	0.94	1.00	1.92	0.25	0.64	1.00	0.29	1.00	1.27	0.88	-0.64	1.00
Disgust	1.20	0.12	-0.18	1.00	-0.30	1.00	1.50	0.01	0.12	1.00	0.30	1.00
Fcz												
Neutral	0.16	1.00	0.17	1.00	-1.01	0.32	1.18	0.08	1.18	0.31	1.01	0.32
Violent	-0.42	1.00	0.06	1.00	-0.80	0.55	0.37	1.00	0.85	0.69	0.80	0.55
Erotic	0.39	1.00	1.48	0.33	0.20	1.00	0.19	1.00	1.28	0.46	-0.20	1.00

Disgust	0.93	0.28	0.08	1.00	-0.28	1.00	1.22	0.03	0.37	1.00	0.28	1.00
Cz												
Neutral	-0.10	1.00	0.89	0.51	1.04	0.09	-1.14	0.02	-0.15	1.00	-1.04	0.09
Violent	-0.23	1.00	1.10	0.27	0.30	1.00	-0.53	1.00	0.81	0.70	-0.30	1.00
Erotic	-0.23	1.00	0.77	0.49	0.56	0.70	-0.79	0.09	0.20	1.00	-0.56	0.70
Disgust	0.19	1.00	0.15	1.00	0.27	1.00	-0.09	1.00	-0.13	1.00	-0.27	1.00
Pz												
Neutral	-0.07	1.00	0.78	1.00	1.57	0.16	-1.65	0.06	-0.80	1.00	-1.57	0.16
Violent	-0.01	1.00	1.92	0.07	1.07	0.49	-1.08	0.30	0.84	1.00	-1.07	0.49
Erotic	-1.30	0.19	0.36	1.00	0.05	1.00	-1.35	0.09	0.31	1.00	-0.05	1.00
Disgust	0.08	1.00	-0.30	1.00	0.59	1.00	-0.51	1.00	-0.89	1.00	-0.59	1.00
200ms												
Fz												
Neutral	-0.18	1.00	-1.84	0.95	-1.74	0.63	1.56	0.62	-0.10	1.00	1.74	0.63
Violent	-1.29	1.00	-0.66	1.00	-2.05	0.44	0.76	1.00	1.39	1.00	2.05	0.44
Erotic	0.09	1.00	1.11	1.00	-0.98	1.00	1.07	1.00	2.10	1.00	0.98	1.00
Disgust	0.76	1.00	-0.91	1.00	-1.23	1.00	1.99	0.22	0.31	1.00	1.23	1.00
Fcz												
Neutral	-0.26	1.00	-1.25	1.00	-1.15	1.00	0.89	1.00	-0.10	1.00	1.15	1.00
Violent	-1.16	1.00	-0.54	1.00	-1.98	0.30	0.82	1.00	1.44	1.00	1.98	0.30

Erotic	-0.15	1.00	0.98	1.00	-1.45	1.00	1.30	1.00	2.43	0.36	1.45	1.00
Disgust	0.59	1.00	-0.66	1.00	-1.02	1.00	1.61	0.43	0.36	1.00	1.02	1.00
Cz												
Neutral	-0.88	1.00	0.21	1.00	1.73	0.15	-2.61	0.00	-1.52	0.52	-1.73	0.15
Violent	0.02	1.00	2.39	0.25	1.91	0.28	-1.89	0.17	0.47	1.00	-1.91	0.28
Erotic	-0.66	1.00	0.30	1.00	-0.59	1.00	-0.06	1.00	0.89	1.00	0.59	1.00
Disgust	0.27	1.00	0.44	1.00	1.00	1.00	-0.73	1.00	-0.57	1.00	-1.00	1.00
Pz												
Neutral	0.14	1.00	1.93	0.58	2.63	0.04	-2.49	0.02	-0.70	1.00	-2.63	0.04
Violent	1.29	0.87	4.48	0.00	3.86	0.00	-2.57	0.01	0.62	1.00	-3.86	0.00
Erotic	-1.09	1.00	1.57	0.69	0.61	1.00	-1.70	0.13	0.96	1.00	-0.61	1.00
Disgust	1.28	1.00	1.41	1.00	2.95	0.02	-1.67	0.36	-1.54	1.00	-2.95	0.02
300ms												
Fz												
Neutral	-0.23	1.00	-1.60	1.00	-0.39	1.00	0.16	1.00	-1.21	1.00	0.39	1.00
Violent	-1.17	1.00	-0.91	1.00	-0.15	1.00	-1.02	1.00	-0.76	1.00	0.15	1.00
Erotic	-0.47	1.00	-1.82	1.00	-0.22	1.00	-0.24	1.00	-1.59	1.00	0.22	1.00
Disgust	0.39	1.00	-1.41	1.00	-0.09	1.00	0.48	1.00	-1.33	1.00	0.09	1.00
Fcz												
Neutral	-0.29	1.00	-1.24	1.00	-0.31	1.00	0.02	1.00	-0.93	1.00	0.31	1.00

Violent	-0.95	1.00	-0.99	1.00	-0.52	1.00	-0.43	1.00	-0.47	1.00	0.52	1.00
Erotic	-0.40	1.00	-1.31	1.00	-0.66	1.00	0.26	1.00	-0.65	1.00	0.66	1.00
Disgust	0.15	1.00	-1.07	1.00	-0.65	1.00	0.79	1.00	-0.42	1.00	0.65	1.00
Cz												
Neutral	-0.76	1.00	-0.57	1.00	0.76	1.00	-1.52	0.24	-1.33	0.96	-0.76	1.00
Violent	-0.06	1.00	2.17	0.60	1.85	0.52	-1.92	0.29	0.32	1.00	-1.85	0.52
Erotic	-1.12	1.00	-0.33	1.00	-0.63	1.00	-0.49	1.00	0.31	1.00	0.63	1.00
Disgust	-0.33	1.00	0.78	1.00	0.44	1.00	-0.77	1.00	0.34	1.00	-0.44	1.00
Pz												
Neutral	-0.03	1.00	1.73	0.58	0.92	1.00	-0.95	1.00	0.81	1.00	-0.92	1.00
Violent	0.87	1.00	4.99	0.00	2.32	0.14	-1.46	0.64	2.67	0.14	-2.32	0.14
Erotic	-1.83	0.38	1.19	1.00	-1.24	1.00	-0.59	1.00	2.44	0.21	1.24	1.00
Disgust	0.73	1.00	2.74	0.26	0.72	1.00	0.02	1.00	2.03	0.66	-0.72	1.00
ELPP												
Fz												
Neutral	-1.50	0.85	-2.11	0.57	-0.59	1.00	-0.91	1.00	-1.53	1.00	0.59	1.00
Violent	-0.62	1.00	0.00	1.00	1.55	1.00	-2.17	0.36	-1.54	1.00	-1.55	1.00
Erotic	-0.80	1.00	-1.66	1.00	1.62	1.00	-2.42	1.00	-3.28	0.89	-1.62	1.00
Disgust	0.08	1.00	-1.27	1.00	1.56	1.00	-1.48	1.00	-2.83	0.40	-1.56	1.00
Fcz												

Neutral	-1.31	0.78	-1.60	0.81	-0.34	1.00	-0.97	1.00	-1.26	1.00	0.34	1.00
Violent	-0.64	1.00	-0.05	1.00	0.95	1.00	-1.59	0.73	-1.00	1.00	-0.95	1.00
Erotic	-1.26	1.00	-1.14	1.00	0.98	1.00	-2.25	0.73	-2.12	1.00	-0.98	1.00
Disgust	-0.32	1.00	-0.92	1.00	0.93	1.00	-1.24	1.00	-1.84	0.95	-0.93	1.00
Cz												
Neutral	-0.88	1.00	-1.03	1.00	0.38	1.00	-1.27	0.23	-1.41	0.43	-0.38	1.00
Violent	0.16	1.00	2.51	0.19	1.39	0.85	-1.23	0.87	1.12	1.00	-1.39	0.85
Erotic	-2.13	0.08	0.20	1.00	-0.23	1.00	-1.90	0.09	0.43	1.00	0.23	1.00
Disgust	-0.72	1.00	0.60	1.00	1.29	0.66	-2.01	0.04	-0.69	1.00	-1.29	0.66
Pz												
Neutral	0.45	1.00	1.08	1.00	0.29	1.00	0.16	1.00	0.79	1.00	-0.29	1.00
Violent	1.06	1.00	3.50	0.01	0.24	1.00	0.82	1.00	3.26	0.02	-0.24	1.00
Erotic	-2.56	0.05	0.54	1.00	-3.58	0.00	1.02	1.00	4.11	0.00	3.58	0.00
Disgust	0.76	1.00	2.12	0.50	0.25	1.00	0.51	1.00	1.87	0.62	-0.25	1.00
LLPP												
Fz												
Neutral	-1.24	1.00	-1.81	0.66	-0.43	1.00	-0.81	1.00	-1.38	1.00	0.43	1.00
Violent	-0.33	1.00	0.55	1.00	1.67	0.64	-2.00	0.19	-1.12	1.00	-1.67	0.64
Erotic	-1.43	1.00	-2.16	1.00	-0.07	1.00	-1.36	1.00	-2.09	1.00	0.07	1.00
Disgust	-0.09	1.00	-0.99	1.00	0.84	1.00	-0.92	1.00	-1.83	1.00	-0.84	1.00

Fcz												
Neutral	-0.97	1.00	-1.28	1.00	-0.18	1.00	-0.79	1.00	-1.10	1.00	0.18	1.00
Violent	-0.53	1.00	0.02	1.00	0.88	1.00	-1.41	0.45	-0.86	1.00	-0.88	1.00
Erotic	-1.81	1.00	-1.67	1.00	-0.44	1.00	-1.37	1.00	-1.23	1.00	0.44	1.00
Disgust	-0.29	1.00	-0.72	1.00	0.30	1.00	-0.59	1.00	-1.02	1.00	-0.30	1.00
Cz												
Neutral	-0.32	1.00	-0.78	1.00	0.19	1.00	-0.51	1.00	-0.97	0.64	-0.19	1.00
Violent	0.81	1.00	2.04	0.24	1.39	0.51	-0.58	1.00	0.64	1.00	-1.39	0.51
Erotic	-1.64	0.11	-0.13	1.00	-0.67	1.00	-0.97	0.73	0.54	1.00	0.67	1.00
Disgust	0.07	1.00	0.70	1.00	0.87	1.00	-0.80	0.95	-0.17	1.00	-0.87	1.00
Pz												
Neutral	0.75	1.00	0.55	1.00	0.35	1.00	0.40	1.00	0.20	1.00	-0.35	1.00
Violent	1.28	0.74	2.76	0.05	0.67	1.00	0.61	1.00	2.09	0.19	-0.67	1.00
Erotic	-1.89	0.07	0.27	1.00	-2.73	0.00	0.85	1.00	3.01	0.00	2.73	0.00
Disgust	0.81	1.00	1.72	0.62	0.89	1.00	-0.07	1.00	0.83	1.00	-0.89	1.00
	Low Agg Female						Low Agg Males					
Region and Image	Low Agg Male		High Agg Male		High Agg Female		Low Agg Female		High Agg Male		High Agg Female	
	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P

100ms												
Fz												
Neutral	-0.29	1.00	-1.49	0.07	-0.13	1.00	0.29	1.00	-1.20	0.64	0.17	1.00
Violent	0.12	1.00	-0.43	1.00	0.15	1.00	-0.12	1.00	-0.55	1.00	0.03	1.00
Erotic	0.98	1.00	-0.29	1.00	-0.94	1.00	-0.98	1.00	-1.27	0.88	-1.92	0.25
Disgust	-1.37	0.12	-1.50	0.01	-1.20	0.12	1.37	0.12	-0.12	1.00	0.18	1.00
Fcz												
Neutral	0.00	1.00	-1.18	0.08	-0.16	1.00	0.00	1.00	-1.18	0.31	-0.17	1.00
Violent	0.48	1.00	-0.37	1.00	0.42	1.00	-0.48	1.00	-0.85	0.69	-0.06	1.00
Erotic	1.09	0.76	-0.19	1.00	-0.39	1.00	-1.09	0.76	-1.28	0.46	-1.48	0.33
Disgust	-0.85	0.69	-1.22	0.03	-0.93	0.28	0.85	0.69	-0.37	1.00	-0.08	1.00
Cz												
Neutral	0.99	0.24	1.14	0.02	0.10	1.00	-0.99	0.24	0.15	1.00	-0.89	0.51
Violent	1.34	0.06	0.53	1.00	0.23	1.00	-1.34	0.06	-0.81	0.70	-1.10	0.27
Erotic	0.99	0.10	0.79	0.09	0.23	1.00	-0.99	0.10	-0.20	1.00	-0.77	0.49
Disgust	-0.04	1.00	0.09	1.00	-0.19	1.00	0.04	1.00	0.13	1.00	-0.15	1.00
Pz												
Neutral	0.85	1.00	1.65	0.06	0.07	1.00	-0.85	1.00	0.80	1.00	-0.78	1.00
Violent	1.92	0.04	1.08	0.30	0.01	1.00	-1.92	0.04	-0.84	1.00	-1.92	0.07
Erotic	1.66	0.11	1.35	0.09	1.30	0.19	-1.66	0.11	-0.31	1.00	-0.36	1.00

Disgust	-0.38	1.00	0.51	1.00	-0.08	1.00	0.38	1.00	0.89	1.00	0.30	1.00
200ms												
Fz												
Neutral	-1.66	1.00	-1.56	0.62	0.18	1.00	1.66	1.00	0.10	1.00	1.84	0.95
Violent	0.63	1.00	-0.76	1.00	1.29	1.00	-0.63	1.00	-1.39	1.00	0.66	1.00
Erotic	1.02	1.00	-1.07	1.00	-0.09	1.00	-1.02	1.00	-2.10	1.00	-1.11	1.00
Disgust	-1.68	0.98	-1.99	0.22	-0.76	1.00	1.68	0.98	-0.31	1.00	0.91	1.00
Fcz												
Neutral	-1.00	1.00	-0.89	1.00	0.26	1.00	1.00	1.00	0.10	1.00	1.25	1.00
Violent	0.62	1.00	-0.82	1.00	1.16	1.00	-0.62	1.00	-1.44	1.00	0.54	1.00
Erotic	1.12	1.00	-1.30	1.00	0.15	1.00	-1.12	1.00	-2.43	0.36	-0.98	1.00
Disgust	-1.25	1.00	-1.61	0.43	-0.59	1.00	1.25	1.00	-0.36	1.00	0.66	1.00
Cz												
Neutral	1.09	1.00	2.61	0.00	0.88	1.00	-1.09	1.00	1.52	0.52	-0.21	1.00
Violent	2.37	0.18	1.89	0.17	-0.02	1.00	-2.37	0.18	-0.47	1.00	-2.39	0.25
Erotic	0.95	1.00	0.06	1.00	0.66	1.00	-0.95	1.00	-0.89	1.00	-0.30	1.00
Disgust	0.16	1.00	0.73	1.00	-0.27	1.00	-0.16	1.00	0.57	1.00	-0.44	1.00
Pz												
Neutral	1.79	0.59	2.49	0.02	-0.14	1.00	-1.79	0.59	0.70	1.00	-1.93	0.58
Violent	3.19	0.01	2.57	0.01	-1.29	0.87	-3.19	0.01	-0.62	1.00	-4.48	0.00

Erotic	2.66	0.03	1.70	0.13	1.09	1.00	-2.66	0.03	-0.96	1.00	-1.57	0.69
Disgust	0.13	1.00	1.67	0.36	-1.28	1.00	-0.13	1.00	1.54	1.00	-1.41	1.00
300ms												
Fz												
Neutral	-1.37	1.00	-0.16	1.00	0.23	1.00	1.37	1.00	1.21	1.00	1.60	1.00
Violent	0.26	1.00	1.02	1.00	1.17	1.00	-0.26	1.00	0.76	1.00	0.91	1.00
Erotic	-1.35	1.00	0.24	1.00	0.47	1.00	1.35	1.00	1.59	1.00	1.82	1.00
Disgust	-1.81	0.98	-0.48	1.00	-0.39	1.00	1.81	0.98	1.33	1.00	1.41	1.00
Fcz												
Neutral	-0.96	1.00	-0.02	1.00	0.29	1.00	0.96	1.00	0.93	1.00	1.24	1.00
Violent	-0.04	1.00	0.43	1.00	0.95	1.00	0.04	1.00	0.47	1.00	0.99	1.00
Erotic	-0.90	1.00	-0.26	1.00	0.40	1.00	0.90	1.00	0.65	1.00	1.31	1.00
Disgust	-1.22	1.00	-0.79	1.00	-0.15	1.00	1.22	1.00	0.42	1.00	1.07	1.00
Cz												
Neutral	0.19	1.00	1.52	0.24	0.76	1.00	-0.19	1.00	1.33	0.96	0.57	1.00
Violent	2.23	0.41	1.92	0.29	0.06	1.00	-2.234	0.41	-0.32	1.00	-2.17	0.60
Erotic	0.79	1.00	0.49	1.00	1.12	1.00	-0.79	1.00	-0.31	1.00	0.33	1.00
Disgust	1.11	1.00	0.77	1.00	0.33	1.00	-1.11	1.00	-0.34	1.00	-0.78	1.00
Pz												
Neutral	1.76	0.42	0.95	1.00	0.03	1.00	-1.76	0.42	-0.81	1.00	-1.73	0.58

Violent	4.13	0.00	1.46	0.64	-0.87	1.00	-4.13	0.00	-2.67	0.14	-4.99	0.00
Erotic	3.03	0.05	0.59	1.00	1.83	0.38	-3.03	0.05	-2.44	0.21	-1.19	1.00
Disgust	2.01	0.65	-0.02	1.00	-0.73	1.00	-2.01	0.65	-2.03	0.66	-2.74	0.26
ELPP												
Fz												
Neutral	-0.62	1.00	0.91	1.00	1.50	0.85	0.62	1.00	1.53	1.00	2.11	0.57
Violent	0.62	1.00	2.17	0.36	0.62	1.00	-0.62	1.00	1.54	1.00	0.00	1.00
Erotic	-0.86	1.00	2.42	1.00	0.80	1.00	0.86	1.00	3.28	0.89	1.66	1.00
Disgust	-1.35	1.00	1.48	1.00	-0.08	1.00	1.35	1.00	2.83	0.40	1.27	1.00
Fcz												
Neutral	-0.29	1.00	0.97	1.00	1.31	0.78	0.29	1.00	1.26	1.00	1.60	0.81
Violent	0.59	1.00	1.59	0.73	0.64	1.00	-0.59	1.00	1.00	1.00	0.05	1.00
Erotic	0.12	1.00	2.25	0.73	1.26	1.00	-0.12	1.00	2.12	1.00	1.14	1.00
Disgust	-0.60	1.00	1.24	1.00	0.32	1.00	0.60	1.00	1.84	0.95	0.92	1.00
Cz												
Neutral	-0.15	1.00	1.27	0.23	0.88	1.00	0.15	1.00	1.41	0.43	1.03	1.00
Violent	2.35	0.18	1.23	0.87	-0.16	1.00	-2.35	0.18	-1.12	1.00	-2.51	0.19
Erotic	2.33	0.11	1.90	0.09	2.13	0.08	-2.33	0.11	-0.43	1.00	-0.20	1.00
Disgust	1.32	0.91	2.01	0.04	0.72	1.00	-1.32	0.91	0.69	1.00	-0.60	1.00
Pz												

Neutral	0.64	1.00	-0.16	1.00	-0.45	1.00	-0.64	1.00	-0.79	1.00	-1.08	1.00
Violent	2.44	0.12	-0.82	1.00	-1.06	1.00	-2.44	0.12	-3.26	0.02	-3.50	0.01
Erotic	3.10	0.03	-1.02	1.00	2.56	0.05	-3.10	0.03	-4.11	0.00	-0.54	1.00
Disgust	1.36	1.00	-0.51	1.00	-0.76	1.00	-1.36	1.00	-1.87	0.62	-2.12	0.50
LLPP												
Fz												
Neutral	-0.57	1.00	0.81	1.00	1.24	1.00	0.57	1.00	1.38	1.00	1.81	0.66
Violent	0.88	1.00	2.00	0.19	0.33	1.00	-0.88	1.00	1.12	1.00	-0.55	1.00
Erotic	-0.73	1.00	1.36	1.00	1.43	1.00	0.73	1.00	2.09	1.00	2.16	1.00
Disgust	-0.91	1.00	0.92	1.00	0.09	1.00	0.91	1.00	1.83	1.00	0.99	1.00
Fcz												
Neutral	-0.31	1.00	0.79	1.00	0.97	1.00	0.31	1.00	1.10	1.00	1.28	1.00
Violent	0.55	1.00	1.41	0.45	0.53	1.00	-0.55	1.00	0.86	1.00	-0.02	1.00
Erotic	0.14	1.00	1.37	1.00	1.81	1.00	-0.14	1.00	1.23	1.00	1.67	1.00
Disgust	-0.43	1.00	0.59	1.00	0.29	1.00	0.43	1.00	1.02	1.00	0.72	1.00
Cz												
Neutral	-0.46	1.00	0.51	1.00	0.32	1.00	0.46	1.00	0.97	0.64	0.78	1.00
Violent	1.22	1.00	0.58	1.00	-0.81	1.00	-1.22	1.00	-0.64	1.00	-2.04	0.24
Erotic	1.51	0.35	0.97	0.73	1.64	0.11	-1.51	0.35	-0.54	1.00	0.13	1.00
Disgust	0.63	1.00	0.80	0.95	-0.07	1.00	-0.63	1.00	0.17	1.00	-0.70	1.00

Pz												
Neutral	-0.20	1.00	-0.40	1.00	-0.75	1.00	0.20	1.00	-0.20	1.00	-0.55	1.00
Violent	1.48	0.73	-0.61	1.00	-1.28	0.74	-1.48	0.73	-2.09	0.19	-2.76	0.05
Erotic	2.16	0.07	-0.85	1.00	1.89	0.07	-2.16	0.07	-3.01	0.00	-0.27	1.00
Disgust	0.91	1.00	0.07	1.00	-0.81	1.00	-0.91	1.00	-0.83	1.00	-1.72	0.62

Appendix O

Chapter 5 - Section 2: Trait Aggression (Data Median – Within Sex) Additional Data

Table of inferential statistics for Chapter 5.5.2 results. One-way independent groups ANOVA (two-tailed) results for mean ERP amplitude for males and females scoring high or low on the Buss and Perry (1992) Aggression Questionnaire, across the electrode site and epoch, in relation to image category. The results below relate to the analysis of a high and low total aggression score that was defined by within-sex median values.

High Agg Fems, High Agg Males, Low Agg Fems and Low Agg Males.					
Image category & Site	100	200	300	ELPP	LLPP
Fz					
Neutral	F(3,77) =2.53 p=0.06	F(3,77) =2.34 p=0.08	F(3,77) =0.9 p=0.44	F(3,77) =1.85 p=0.14	F(3,77) =1.24 p=0.3
Violent	F(3,77) =0.32 p=0.81	F(3,77) =1.83 p=0.15	F(3,77) =0.57 p=0.64	F(3,77) =1.58 p=0.2	F(3,77) =1.68 p=0.18
Erotic	F(3,77) =1.19 p=0.32	F(3,77) =0.88 p=0.45	F(3,77) =0.46 p=0.71	F(3,77) =0.83 p=0.48	F(3,77) =0.65 p=0.59
Disgust	F(3,77) =2.59 p=0.06	F(3,77) =1.74 p=0.17	F(3,77) =1 p=0.4	F(3,77) =1.17 p=0.33	F(3,77) =0.44 p=0.73
Fcz					

Neutral	F(3,77) =2.12 p=0.11	F(3,77) =1.88 p=0.14	F(3,77) =0.94 p=0.42	F(3,77) =1.88 p=0.14	F(3,77) =1.03 p=0.38
Violent	F(3,77) =0.55 p=0.65	F(3,77) =2.4 p=0.07	F(3,77) =0.57 p=0.64	F(3,77) =1.1 p=0.36	F(3,77) =0.96 p=0.42
Erotic	F(3,77) =1.76 p=0.16	F(3,77) =1.53 p=0.21	F(3,77) =0.43 p=0.73	F(3,77) =0.51 p=0.67	F(3,77) =0.35 p=0.79
Disgust	F(3,77) =1.78 p=0.16	F(3,77) =1.54 p=0.21	F(3,77) =1.27 p=0.29	F(3,77) =0.82 p=0.49	F(3,77) =0.31 p=0.82
Cz					
Neutral	F(3,77) =4.43 p=0.01	F(3,77) =4.36 p=0.01	F(3,77) =0.78 p=0.51	F(3,77) =0.94 p=0.43	F(3,77) =0.68 p=0.57
Violent	F(3,77) =2.09 p=0.11	F(3,77) =3.05 p=0.03	F(3,77) =2.29 p=0.09	F(3,77) =2.15 p=0.1	F(3,77) =1.28 p=0.29
Erotic	F(3,77) =3.77 p=0.01	F(3,77) =0.56 p=0.64	F(3,77) =0.62 p=0.61	F(3,77) =2.69 p=0.05	F(3,77) =1.81 p=0.15
Disgust	F(3,77) =0.22 p=0.88	F(3,77) =0.66 p=0.58	F(3,77) =0.65 p=0.59	F(3,77) =2.37 p=0.08	F(3,77) =1.07 p=0.37
Pz					
Neutral	F(3,77) =2.55 p=0.06	F(3,77) =4.17 p=0.01	F(3,77) =1.96 p=0.13	F(3,77) =0.52 p=0.67	F(3,77) =0.16 p=0.92
Violent	F(3,77) =4.02 p=0.01	F(3,77) =9.67 p=0	F(3,77) =6.5 p=0	F(3,77) =3.11 p=0.03	F(3,77) =1.55 p=0.21

Erotic	F(3,77) =2.31 p=0.08	F(3,77) =3.3 p=0.02	F(3,77) =3.28 p=0.03	F(3,77) =7.32 p=0	F(3,77) =7.47 p=0
Disgust	F(3,77) =0.23 p=0.88	F(3,77) =2.87 p=0.04	F(3,77) =2.13 p=0.1	F(3,77) =1.5 p=0.22	F(3,77) =1.24 p=0.3

*Highlighted values show significant results

Appendix P

Chapter 5 - Section 2: Trait Aggression (Data Median-Within Sex) Post Hoc Tests

Post Hoc Tests

Table of Bonferroni Post Hoc Test results to show which groups differ for the ANOVAs (Appendix O).

	High Agg Female						High Agg Males					
Region and Image	Low Agg Female		Low Agg Male		High Agg Male		Low Agg Female		Low Agg Male		High Agg Female	
	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P
100ms												
Fz												
Neutral	-0.32	1.00	-0.58	1.00	-1.58	0.06	1.27	0.28	1.00	0.97	1.58	0.06
Violent	-0.27	1.00	-0.41	1.00	-0.46	1.00	0.19	1.00	0.05	1.00	0.46	1.00
Erotic	0.76	1.00	1.53	0.43	0.42	1.00	0.34	1.00	1.11	1.00	-0.42	1.00
Disgust	0.49	1.00	-0.66	1.00	-0.82	0.62	1.31	0.08	0.16	1.00	0.82	0.62
Fcz												
Neutral	-0.27	1.00	-0.33	1.00	-1.18	0.11	0.91	0.46	0.85	0.87	1.18	0.11
Violent	-0.39	1.00	-0.29	1.00	-0.56	1.00	0.16	1.00	0.27	1.00	0.56	1.00
Erotic	0.44	1.00	1.43	0.23	0.06	1.00	0.38	1.00	1.37	0.29	-0.06	1.00

Disgust	0.23	1.00	-0.37	1.00	-0.78	0.53	1.01	0.21	0.41	1.00	0.78	0.53
Cz												
Neutral	0.32	1.00	1.14	0.08	1.24	0.01	-0.92	0.15	-0.10	1.00	-1.24	0.01
Violent	0.41	1.00	1.14	0.13	0.73	0.51	-0.32	1.00	0.40	1.00	-0.73	0.51
Erotic	0.04	1.00	1.13	0.03	0.57	0.53	-0.53	0.74	0.57	0.89	-0.57	0.53
Disgust	0.25	1.00	0.18	1.00	0.27	1.00	-0.02	1.00	-0.10	1.00	-0.27	1.00
Pz												
Neutral	0.18	1.00	1.23	0.67	1.58	0.11	-1.40	0.27	-0.35	1.00	-1.58	0.11
Violent	0.74	1.00	2.08	0.01	1.46	0.07	-0.72	1.00	0.61	1.00	-1.46	0.07
Erotic	-0.78	1.00	0.93	1.00	0.36	1.00	-1.14	0.37	0.57	1.00	-0.36	1.00
Disgust	0.38	1.00	0.26	1.00	0.55	1.00	-0.17	1.00	-0.29	1.00	-0.55	1.00
200ms												
Fz												
Neutral	-1.46	0.91	-2.23	0.33	-2.41	0.10	0.95	1.00	0.18	1.00	2.41	0.10
Violent	-2.08	0.34	-1.18	1.00	-2.17	0.25	0.08	1.00	0.98	1.00	2.17	0.25
Erotic	0.97	1.00	1.34	1.00	-0.67	1.00	1.65	1.00	2.02	1.00	0.67	1.00
Disgust	-0.87	1.00	-1.83	0.70	-2.09	0.23	1.22	1.00	0.26	1.00	2.09	0.23
Fcz												
Neutral	-1.51	0.50	-1.74	0.48	-1.73	0.26	0.21	1.00	-0.01	1.00	1.73	0.26
Violent	-2.13	0.16	-1.23	1.00	-2.17	0.13	0.04	1.00	0.94	1.00	2.17	0.13

Erotic	0.59	1.00	1.15	1.00	-1.19	1.00	1.79	0.60	2.34	0.35	1.19	1.00
Disgust	-1.10	1.00	-1.62	0.81	-1.86	0.28	0.77	1.00	0.24	1.00	1.86	0.28
Cz												
Neutral	-0.44	1.00	0.78	1.00	2.05	0.03	-2.49	0.01	-1.27	0.83	-2.05	0.03
Violent	-0.18	1.00	1.90	0.42	2.00	0.16	-2.18	0.12	-0.10	1.00	-2.00	0.16
Erotic	-0.54	1.00	0.40	1.00	-0.50	1.00	-0.04	1.00	0.90	1.00	0.50	1.00
Disgust	0.07	1.00	0.22	1.00	0.97	1.00	-0.90	1.00	-0.76	1.00	-0.97	1.00
Pz												
Neutral	0.71	1.00	2.51	0.10	2.75	0.02	-2.03	0.18	-0.24	1.00	-2.75	0.02
Violent	1.41	0.63	4.07	0.00	3.84	0.00	-2.43	0.04	0.23	1.00	-3.84	0.00
Erotic	-0.86	1.00	1.83	0.25	0.78	1.00	-1.64	0.24	1.05	1.00	-0.78	1.00
Disgust	1.49	0.72	1.96	0.43	2.63	0.03	-1.14	1.00	-0.67	1.00	-2.63	0.03
300ms												
Fz												
Neutral	-1.37	1.00	-1.63	1.00	-1.06	1.00	-0.32	1.00	-0.57	1.00	1.06	1.00
Violent	-1.70	1.00	-0.93	1.00	-0.20	1.00	-1.50	1.00	-0.73	1.00	0.20	1.00
Erotic	1.42	1.00	-0.39	1.00	0.58	1.00	0.84	1.00	-0.97	1.00	-0.58	1.00
Disgust	-1.39	1.00	-1.95	0.70	-1.05	1.00	-0.34	1.00	-0.90	1.00	1.05	1.00
Fcz												
Neutral	-1.32	0.84	-1.30	1.00	-0.89	1.00	-0.43	1.00	-0.41	1.00	0.89	1.00

Violent	-1.63	1.00	-1.08	1.00	-0.71	1.00	-0.92	1.00	-0.37	1.00	0.71	1.00
Erotic	1.10	1.00	-0.15	1.00	-0.08	1.00	1.18	1.00	-0.06	1.00	0.08	1.00
Disgust	-1.48	0.78	-1.63	0.84	-1.51	0.68	0.03	1.00	-0.12	1.00	1.51	0.68
Cz												
Neutral	-0.30	1.00	0.30	1.00	0.88	1.00	-1.18	0.90	-0.57	1.00	-0.88	1.00
Violent	-0.16	1.00	2.10	0.46	1.81	0.45	-1.97	0.37	0.29	1.00	-1.81	0.45
Erotic	-0.71	1.00	0.40	1.00	-0.54	1.00	-0.17	1.00	0.94	1.00	0.54	1.00
Disgust	-0.36	1.00	0.89	1.00	0.39	1.00	-0.76	1.00	0.50	1.00	-0.39	1.00
Pz												
Neutral	0.44	1.00	2.14	0.13	0.96	1.00	-0.52	1.00	1.18	1.00	-0.96	1.00
Violent	0.99	1.00	4.64	0.00	2.19	0.14	-1.20	1.00	2.45	0.18	-2.19	0.14
Erotic	-1.58	0.60	1.61	0.84	-1.11	1.00	-0.47	1.00	2.72	0.09	1.11	1.00
Disgust	0.95	1.00	2.88	0.10	0.44	1.00	0.50	1.00	2.44	0.27	-0.44	1.00
ELPP												
Fz												
Neutral	-2.17	0.18	-1.71	0.77	-0.86	1.00	-1.31	1.00	-0.85	1.00	0.86	1.00
Violent	-1.32	1.00	-0.09	1.00	1.36	1.00	-2.68	0.20	-1.45	1.00	-1.36	1.00
Erotic	1.66	1.00	0.39	1.00	2.70	0.88	-1.04	1.00	-2.31	1.00	-2.70	0.88
Disgust	-1.17	1.00	-1.30	1.00	0.89	1.00	-2.05	0.69	-2.19	0.83	-0.89	1.00
Fcz												

Neutral	-1.88	0.16	-1.24	1.00	-0.57	1.00	-1.31	0.74	-0.67	1.00	0.57	1.00
Violent	-1.16	1.00	-0.11	1.00	0.83	1.00	-2.00	0.45	-0.94	1.00	-0.83	1.00
Erotic	0.72	1.00	0.65	1.00	1.87	1.00	-1.15	1.00	-1.22	1.00	-1.87	1.00
Disgust	-1.14	1.00	-0.74	1.00	0.45	1.00	-1.59	0.91	-1.19	1.00	-0.45	1.00
Cz												
Neutral	-0.49	1.00	-0.31	1.00	0.57	1.00	-1.06	0.70	-0.88	1.00	-0.57	1.00
Violent	0.20	1.00	2.18	0.23	1.48	0.59	-1.28	1.00	0.69	1.00	-1.48	0.59
Erotic	-1.51	0.44	1.11	1.00	0.13	1.00	-1.64	0.33	0.98	1.00	-0.13	1.00
Disgust	-0.16	1.00	1.13	1.00	1.61	0.22	-1.77	0.16	-0.48	1.00	-1.61	0.22
Pz												
Neutral	0.59	1.00	1.01	1.00	0.27	1.00	0.32	1.00	0.74	1.00	-0.27	1.00
Violent	1.28	0.93	2.84	0.04	0.26	1.00	1.02	1.00	2.58	0.08	-0.26	1.00
Erotic	-2.21	0.11	0.80	1.00	-3.28	0.00	1.08	1.00	4.09	0.00	3.28	0.00
Disgust	1.35	0.95	2.01	0.39	0.41	1.00	0.94	1.00	1.60	0.86	-0.41	1.00
LLPP												
Fz												
Neutral	-1.45	0.63	-1.42	0.97	-0.41	1.00	-1.04	1.00	-1.01	1.00	0.41	1.00
Violent	0.08	1.00	0.92	1.00	1.93	0.29	-1.85	0.41	-1.01	1.00	-1.93	0.29
Erotic	1.95	1.00	0.21	1.00	1.54	1.00	0.41	1.00	-1.33	1.00	-1.54	1.00
Disgust	-0.77	1.00	-0.73	1.00	0.36	1.00	-1.13	1.00	-1.08	1.00	-0.36	1.00

Fcz												
Neutral	-1.11	0.86	-0.96	1.00	-0.15	1.00	-0.95	1.00	-0.81	1.00	0.15	1.00
Violent	-0.10	1.00	0.39	1.00	1.18	0.94	-1.28	0.83	-0.79	1.00	-1.18	0.94
Erotic	1.31	1.00	0.64	1.00	1.02	1.00	0.30	1.00	-0.37	1.00	-1.02	1.00
Disgust	-0.78	1.00	-0.45	1.00	-0.07	1.00	-0.71	1.00	-0.39	1.00	0.07	1.00
Cz												
Neutral	-0.37	1.00	-0.53	1.00	0.16	1.00	-0.53	1.00	-0.69	1.00	-0.16	1.00
Violent	0.28	1.00	1.37	0.75	1.15	0.79	-0.88	1.00	0.22	1.00	-1.15	0.79
Erotic	-1.16	0.53	0.54	1.00	-0.40	1.00	-0.76	1.00	0.94	1.00	0.40	1.00
Disgust	0.14	1.00	0.64	1.00	0.96	0.65	-0.82	1.00	-0.32	1.00	-0.96	0.65
Pz												
Neutral	0.36	1.00	0.33	1.00	0.01	1.00	0.35	1.00	0.31	1.00	-0.01	1.00
Violent	1.04	1.00	1.92	0.26	0.52	1.00	0.52	1.00	1.40	0.84	-0.52	1.00
Erotic	-2.06	0.03	0.18	1.00	-2.66	0.00	0.60	1.00	2.85	0.00	2.66	0.00
Disgust	1.19	0.90	1.60	0.53	0.98	1.00	0.21	1.00	0.62	1.00	-0.98	1.00
	Low Agg Female						Low Agg Males					
Region and Image	Low Agg Male		High Agg Male		High Agg Female		Low Agg Female		High Agg Male		High Agg Female	
	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P
100ms												

Fz												
Neutral	-0.27	1.00	-1.27	0.28	0.32	1.00	0.27	1.00	-1.00	0.97	0.58	1.00
Violent	-0.14	1.00	-0.19	1.00	0.27	1.00	0.14	1.00	-0.05	1.00	0.41	1.00
Erotic	0.77	1.00	-0.34	1.00	-0.76	1.00	-0.77	1.00	-1.11	1.00	-1.53	0.43
Disgust	-1.15	0.34	-1.31	0.08	-0.49	1.00	1.15	0.34	-0.16	1.00	0.66	1.00
Fcz												
Neutral	-0.06	1.00	-0.91	0.46	0.27	1.00	0.06	1.00	-0.85	0.87	0.33	1.00
Violent	0.11	1.00	-0.16	1.00	0.39	1.00	-0.11	1.00	-0.27	1.00	0.29	1.00
Erotic	0.99	0.94	-0.38	1.00	-0.44	1.00	-0.99	0.94	-1.37	0.29	-1.43	0.23
Disgust	-0.59	1.00	-1.01	0.21	-0.23	1.00	0.59	1.00	-0.41	1.00	0.37	1.00
Cz												
Neutral	0.82	0.50	0.92	0.15	-0.32	1.00	-0.82	0.50	0.10	1.00	-1.14	0.08
Violent	0.73	0.91	0.32	1.00	-0.41	1.00	-0.73	0.91	-0.40	1.00	-1.14	0.13
Erotic	1.10	0.04	0.53	0.74	-0.04	1.00	-1.10	0.04	-0.57	0.89	-1.13	0.03
Disgust	-0.08	1.00	0.02	1.00	-0.25	1.00	0.08	1.00	0.10	1.00	-0.18	1.00
Pz												
Neutral	1.05	1.00	1.40	0.27	-0.18	1.00	-1.05	1.00	0.35	1.00	-1.23	0.67
Violent	1.33	0.32	0.72	1.00	-0.74	1.00	-1.33	0.32	-0.61	1.00	-2.08	0.01
Erotic	1.71	0.09	1.14	0.37	0.78	1.00	-1.71	0.09	-0.57	1.00	-0.93	1.00
Disgust	-0.12	1.00	0.17	1.00	-0.38	1.00	0.12	1.00	0.29	1.00	-0.26	1.00

200ms												
Fz												
Neutral	-0.77	1.00	-0.95	1.00	1.46	0.91	0.77	1.00	-0.18	1.00	2.23	0.33
Violent	0.90	1.00	-0.08	1.00	2.08	0.34	-0.90	1.00	-0.98	1.00	1.18	1.00
Erotic	0.37	1.00	-1.65	1.00	-0.97	1.00	-0.37	1.00	-2.02	1.00	-1.34	1.00
Disgust	-0.96	1.00	-1.22	1.00	0.87	1.00	0.96	1.00	-0.26	1.00	1.83	0.70
Fcz												
Neutral	-0.23	1.00	-0.21	1.00	1.51	0.50	0.23	1.00	0.01	1.00	1.74	0.48
Violent	0.90	1.00	-0.04	1.00	2.13	0.16	-0.90	1.00	-0.94	1.00	1.23	1.00
Erotic	0.55	1.00	-1.79	0.60	-0.59	1.00	-0.55	1.00	-2.34	0.35	-1.15	1.00
Disgust	-0.52	1.00	-0.77	1.00	1.10	1.00	0.52	1.00	-0.24	1.00	1.62	0.81
Cz												
Neutral	1.22	0.97	2.49	0.01	0.44	1.00	-1.22	0.97	1.27	0.83	-0.78	1.00
Violent	2.08	0.32	2.18	0.12	0.18	1.00	-2.08	0.32	0.10	1.00	-1.90	0.42
Erotic	0.94	1.00	0.04	1.00	0.54	1.00	-0.94	1.00	-0.90	1.00	-0.40	1.00
Disgust	0.15	1.00	0.90	1.00	-0.07	1.00	-0.15	1.00	0.76	1.00	-0.22	1.00
Pz												
Neutral	1.79	0.57	2.03	0.18	-0.71	1.00	-1.79	0.57	0.24	1.00	-2.51	0.10
Violent	2.66	0.06	2.43	0.04	-1.41	0.63	-2.66	0.06	-0.23	1.00	-4.07	0.00
Erotic	2.69	0.02	1.64	0.24	0.86	1.00	-2.69	0.02	-1.05	1.00	-1.83	0.25

Disgust	0.48	1.00	1.14	1.00	-1.49	0.72	-0.48	1.00	0.67	1.00	-1.96	0.43
300ms												
Fz												
Neutral	-0.26	1.00	0.32	1.00	1.37	1.00	0.26	1.00	0.57	1.00	1.63	1.00
Violent	0.76	1.00	1.50	1.00	1.70	1.00	-0.76	1.00	0.73	1.00	0.93	1.00
Erotic	-1.81	1.00	-0.84	1.00	-1.42	1.00	1.81	1.00	0.97	1.00	0.39	1.00
Disgust	-0.56	1.00	0.34	1.00	1.39	1.00	0.56	1.00	0.90	1.00	1.95	0.70
Fcz												
Neutral	0.01	1.00	0.43	1.00	1.32	0.84	-0.01	1.00	0.41	1.00	1.30	1.00
Violent	0.55	1.00	0.92	1.00	1.63	1.00	-0.55	1.00	0.37	1.00	1.08	1.00
Erotic	-1.25	1.00	-1.18	1.00	-1.10	1.00	1.25	1.00	0.06	1.00	0.15	1.00
Disgust	-0.16	1.00	-0.03	1.00	1.48	0.78	0.16	1.00	0.12	1.00	1.63	0.84
Cz												
Neutral	0.60	1.00	1.18	0.90	0.30	1.00	-0.60	1.00	0.57	1.00	-0.30	1.00
Violent	2.26	0.38	1.97	0.37	0.16	1.00	-2.26	0.38	-0.29	1.00	-2.10	0.46
Erotic	1.11	1.00	0.17	1.00	0.71	1.00	-1.11	1.00	-0.94	1.00	-0.40	1.00
Disgust	1.26	1.00	0.76	1.00	0.36	1.00	-1.26	1.00	-0.50	1.00	-0.89	1.00
Pz												
Neutral	1.70	0.45	0.52	1.00	-0.44	1.00	-1.70	0.45	-1.18	1.00	-2.14	0.13
Violent	3.65	0.01	1.20	1.00	-0.99	1.00	-3.65	0.01	-2.45	0.18	-4.64	0.00

Erotic	3.18	0.03	0.47	1.00	1.58	0.60	-3.18	0.03	-2.72	0.09	-1.61	0.84
Disgust	1.94	0.69	-0.50	1.00	-0.95	1.00	-1.94	0.69	-2.44	0.27	-2.88	0.10
ELPP												
Fz												
Neutral	0.46	1.00	1.31	1.00	2.17	0.18	-0.46	1.00	0.85	1.00	1.71	0.77
Violent	1.23	1.00	2.68	0.20	1.32	1.00	-1.23	1.00	1.45	1.00	0.09	1.00
Erotic	-1.27	1.00	1.04	1.00	-1.66	1.00	1.27	1.00	2.31	1.00	-0.39	1.00
Disgust	-0.13	1.00	2.05	0.69	1.17	1.00	0.13	1.00	2.19	0.83	1.30	1.00
Fcz												
Neutral	0.63	1.00	1.31	0.74	1.88	0.16	-0.63	1.00	0.67	1.00	1.24	1.00
Violent	1.05	1.00	2.00	0.45	1.16	1.00	-1.05	1.00	0.94	1.00	0.11	1.00
Erotic	-0.08	1.00	1.15	1.00	-0.72	1.00	0.08	1.00	1.22	1.00	-0.65	1.00
Disgust	0.40	1.00	1.59	0.91	1.14	1.00	-0.40	1.00	1.19	1.00	0.74	1.00
Cz												
Neutral	0.18	1.00	1.06	0.70	0.49	1.00	-0.18	1.00	0.88	1.00	0.31	1.00
Violent	1.97	0.40	1.28	1.00	-0.20	1.00	-1.97	0.40	-0.69	1.00	-2.18	0.23
Erotic	2.62	0.05	1.64	0.33	1.51	0.44	-2.62	0.05	-0.98	1.00	-1.11	1.00
Disgust	1.29	0.95	1.77	0.16	0.16	1.00	-1.29	0.95	0.48	1.00	-1.13	1.00
Pz												
Neutral	0.42	1.00	-0.32	1.00	-0.59	1.00	-0.42	1.00	-0.74	1.00	-1.01	1.00

Violent	1.56	0.82	-1.02	1.00	-1.28	0.93	-1.56	0.82	-2.58	0.08	-2.84	0.04
Erotic	3.01	0.04	-1.08	1.00	2.21	0.11	-3.01	0.04	-4.09	0.00	-0.80	1.00
Disgust	0.66	1.00	-0.94	1.00	-1.35	0.95	-0.66	1.00	-1.60	0.86	-2.01	0.39
LLPP												
Fz												
Neutral	0.03	1.00	1.04	1.00	1.45	0.63	-0.03	1.00	1.01	1.00	1.42	0.97
Violent	0.84	1.00	1.85	0.41	-0.08	1.00	-0.84	1.00	1.01	1.00	-0.92	1.00
Erotic	-1.74	1.00	-0.41	1.00	-1.95	1.00	1.74	1.00	1.33	1.00	-0.21	1.00
Disgust	0.05	1.00	1.13	1.00	0.77	1.00	-0.05	1.00	1.08	1.00	0.73	1.00
Fcz												
Neutral	0.14	1.00	0.95	1.00	1.11	0.86	-0.14	1.00	0.81	1.00	0.96	1.00
Violent	0.49	1.00	1.28	0.83	0.10	1.00	-0.49	1.00	0.79	1.00	-0.39	1.00
Erotic	-0.67	1.00	-0.30	1.00	-1.31	1.00	0.67	1.00	0.37	1.00	-0.64	1.00
Disgust	0.33	1.00	0.71	1.00	0.78	1.00	-0.33	1.00	0.39	1.00	0.45	1.00
Cz												
Neutral	-0.16	1.00	0.53	1.00	0.37	1.00	0.16	1.00	0.69	1.00	0.53	1.00
Violent	1.09	1.00	0.88	1.00	-0.28	1.00	-1.09	1.00	-0.22	1.00	-1.37	0.75
Erotic	1.70	0.20	0.76	1.00	1.16	0.53	-1.70	0.20	-0.94	1.00	-0.54	1.00
Disgust	0.50	1.00	0.82	1.00	-0.14	1.00	-0.50	1.00	0.32	1.00	-0.64	1.00
Pz												

Neutral	-0.03	1.00	-0.35	1.00	-0.36	1.00	0.03	1.00	-0.31	1.00	-0.33	1.00
Violent	0.88	1.00	-0.52	1.00	-1.04	1.00	-0.88	1.00	-1.40	0.84	-1.92	0.26
Erotic	2.24	0.05	-0.60	1.00	2.06	0.03	-2.24	0.05	-2.85	0.00	-0.18	1.00
Disgust	0.41	1.00	-0.21	1.00	-1.19	0.90	-0.41	1.00	-0.62	1.00	-1.60	0.53

*Highlighted values show significant results

Appendix Q

Chapter 5 - Section 3: Trait Aggression (25th and 75th Percentile - Overall) Additional Data

Table of inferential statistics for Chapter 5.5.3 results. One-way independent groups ANOVA (two-tailed) results for mean ERP amplitude for males and females scoring high or low on the Buss and Perry (1992) Aggression Questionnaire, across the electrode site and epoch, in relation to image category. The results below relate to the analysis of a high and low total aggression scores for both males and females, that was defined by the overall total aggression score percentiles (i.e. 25th percentile = 57.25; 75th percentile =81.25).

High Agg Fems, High Agg Males, Low Agg Fems and Low Agg Males.					
Image category & Site	100	200	300	ELPP	LLPP
Fz					
Neutral	F(3,37) =1.6 p=0.21	F(3,37) =3.55 p=0.02	F(3,37) =0.42 p=0.74	F(3,37) =0.59 p=0.63	F(3,37) =1.25 p=0.31
Violent	F(3,37) =0.76 p=0.52	F(3,37) =3.2 p=0.04	F(3,37) =0.75 p=0.53	F(3,37) =0.22 p=0.88	F(3,37) =0.04 p=0.99
Erotic	F(3,37) =1.32 p=0.28	F(3,37) =1.47 p=0.24	F(3,37) =0.62 p=0.61	F(3,37) =0.34 p=0.79	F(3,37) =1.51 p=0.23
Disgust	F(3,37) =2.39 p=0.09	F(3,37) =3.44 p=0.03	F(3,37) =1.1 p=0.36	F(3,37) =1.14 p=0.35	F(3,37) =3.2 p=0.04
Fcz					

Neutral	F(3,37) =1.54 p=0.22	F(3,37) =2.83 p=0.05	F(3,37) =0.48 p=0.7	F(3,37) =0.75 p=0.53	F(3,37) =1.23 p=0.31
Violent	F(3,37) =1.84 p=0.16	F(3,37) =5.2 p<0.01	F(3,37) =1.69 p=0.19	F(3,37) =0.79 p=0.51	F(3,37) =0.09 p=0.96
Erotic	F(3,37) =1.45 p=0.24	F(3,37) =2.61 p=0.07	F(3,37) =1.08 p=0.37	F(3,37) =0.27 p=0.85	F(3,37) =1.81 p=0.16
Disgust	F(3,37) =1.67 p=0.19	F(3,37) =2.66 p=0.06	F(3,37) =1.69 p=0.19	F(3,37) =1.34 p=0.28	F(3,37) =3.15 p=0.04
Cz					
Neutral	F(3,37) =1.97 p=0.14	F(3,37) =1.05 p=0.38	F(3,37) =1.06 p=0.38	F(3,37) =0.72 p=0.55	F(3,37) =1.2 p=0.32
Violent	F(3,37) =1.49 p=0.24	F(3,37) =2.21 p=0.1	F(3,37) =3.92 p=0.02	F(3,37) =3.13 p=0.04	F(3,37) =2.07 p=0.12
Erotic	F(3,37) =1.29 p=0.29	F(3,37) =3.17 p=0.04	F(3,37) =3.42 p=0.03	F(3,37) =3.27 p=0.03	F(3,37) =3.7 p=0.02
Disgust	F(3,37) =3.22 p=0.03	F(3,37) =0.98 p=0.41	F(3,37) =2.06 p=0.12	F(3,37) =0.66 p=0.58	F(3,37) =0.37 p=0.77
Pz					
Neutral	F(3,37) =1.18 p=0.33	F(3,37) =1.96 p=0.14	F(3,37) =2.86 p=0.05	F(3,37) =3.12 p=0.04	F(3,37) =2.76 p=0.06
Violent	F(3,37) =1.26 p=0.3	F(3,37) =3.12 p=0.04	F(3,37) =4.17 p=0.01	F(3,37) =2.98 p=0.05	F(3,37) =2.84 p=0.05

Erotic	F(3,37) =1.03 p=0.39	F(3,37) =0.53 p=0.66	F(3,37) =2.57 p=0.07	F(3,37) =6.18 p<0.01	F(3,37) =7.82 p<0.01
Disgust	F(3,37) =0.72 p=0.55	F(3,37) =1.03 p=0.39	F(3,37) =0.69 p=0.56	F(3,37) =0.34 p=0.79	F(3,37) =0.42 p=0.74

*Highlighted values show significant results

Appendix R

Chapter 5- Section 3: Trait Aggression (25th and 75th Percentile - Overall) Post Hoc Tests

Table of Bonferroni Post Hoc Test results to show which groups differ for the ANOVAs (Appendix Q).

	High Agg Female						High Agg Males					
Region and Image	Low Agg Female		Low Agg Male		High Agg Male		Low Agg Female		Low Agg Male		High Agg Female	
	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P
100ms												
Fz												
Neutral	-0.04	1.00	-0.37	1.00	-1.82	0.44	1.78	0.37	1.45	1.00	1.82	0.44
Violent	-0.99	0.89	-0.35	1.00	-0.53	1.00	-0.46	1.00	0.18	1.00	0.53	1.00
Erotic	-0.01	1.00	1.68	0.78	1.10	1.00	-1.10	1.00	0.58	1.00	-1.10	1.00
Disgust	0.72	1.00	-0.40	1.00	-0.96	1.00	1.67	0.08	0.56	1.00	0.96	1.00
Fcz												
Neutral	-0.32	1.00	-0.25	1.00	-1.48	0.36	1.17	0.66	1.23	0.85	1.48	0.36
Violent	-1.34	0.20	-0.37	1.00	-0.83	1.00	-0.51	1.00	0.46	1.00	0.83	1.00
Erotic	-0.64	1.00	1.00	1.00	0.25	1.00	-0.89	1.00	0.76	1.00	-0.25	1.00
Disgust	-0.05	1.00	-0.53	1.00	-1.17	0.39	1.13	0.35	0.64	1.00	1.17	0.39
Cz												

Neutral	0.04	1.00	1.32	0.32	0.77	1.00	-0.73	1.00	0.55	1.00	-0.77	1.00
Violent	0.00	1.00	1.31	0.47	0.46	1.00	-0.47	1.00	0.84	1.00	-0.46	1.00
Erotic	-0.43	1.00	0.52	1.00	0.15	1.00	-0.57	1.00	0.37	1.00	-0.15	1.00
Disgust	0.01	1.00	1.24	0.12	-0.17	1.00	0.18	1.00	1.41	0.04	0.17	1.00
Pz												
Neutral	0.18	1.00	1.75	0.75	1.14	1.00	-0.96	1.00	0.61	1.00	-1.14	1.00
Violent	0.51	1.00	1.50	0.57	1.16	0.93	-0.65	1.00	0.34	1.00	-1.16	0.93
Erotic	-0.90	1.00	0.04	1.00	-0.94	1.00	0.04	1.00	0.99	1.00	0.94	1.00
Disgust	0.29	1.00	1.38	1.00	0.25	1.00	0.04	1.00	1.13	1.00	-0.25	1.00
200ms												
Fz												
Neutral	0.03	1.00	-1.10	1.00	-3.64	0.06	3.67	0.04	2.55	0.51	3.64	0.06
Violent	-1.00	1.00	0.74	1.00	-3.26	0.12	2.27	0.47	4.01	0.05	3.26	0.12
Erotic	1.00	1.00	2.13	1.00	-1.31	1.00	2.31	0.83	3.44	0.35	1.31	1.00
Disgust	0.69	1.00	0.32	1.00	-2.83	0.19	3.52	0.03	3.15	0.16	2.83	0.19
Fcz												
Neutral	-0.35	1.00	-0.68	1.00	-2.88	0.09	2.54	0.12	2.20	0.45	2.88	0.09
Violent	-1.47	1.00	0.66	1.00	-3.44	0.02	1.97	0.37	4.10	0.01	3.44	0.02
Erotic	0.50	1.00	1.61	1.00	-2.04	0.75	2.54	0.26	3.65	0.08	2.04	0.75
Disgust	0.02	1.00	0.12	1.00	-2.69	0.19	2.71	0.13	2.81	0.22	2.69	0.19

Cz												
Neutral	0.01	1.00	1.42	1.00	1.09	1.00	-1.08	1.00	0.33	1.00	-1.09	1.00
Violent	0.41	1.00	3.25	0.14	0.98	1.00	-0.57	1.00	2.27	0.59	-0.98	1.00
Erotic	0.17	1.00	0.96	1.00	-1.58	0.37	1.75	0.17	2.54	0.04	1.58	0.37
Disgust	0.95	1.00	1.74	0.73	0.36	1.00	0.59	1.00	1.38	1.00	-0.36	1.00
Pz												
Neutral	0.12	1.00	2.27	0.74	2.36	0.49	-2.24	0.45	-0.09	1.00	-2.36	0.49
Violent	0.76	1.00	2.91	0.30	3.39	0.08	-2.63	0.23	-0.48	1.00	-3.39	0.08
Erotic	-1.00	1.00	0.09	1.00	-0.74	1.00	-0.26	1.00	0.83	1.00	0.74	1.00
Disgust	1.43	1.00	1.09	1.00	2.85	0.55	-1.42	1.00	-1.77	1.00	-2.85	0.55
300ms												
Fz												
Neutral	0.28	1.00	-0.78	1.00	-1.06	1.00	1.34	1.00	0.29	1.00	1.06	1.00
Violent	-0.79	1.00	0.54	1.00	-2.45	1.00	1.65	1.00	2.98	1.00	2.45	1.00
Erotic	0.95	1.00	-1.44	1.00	-1.22	1.00	2.18	1.00	-0.22	1.00	1.22	1.00
Disgust	-1.01	1.00	-1.88	1.00	-2.70	0.55	1.70	1.00	0.83	1.00	2.70	0.55
Fcz												
Neutral	-0.12	1.00	-0.54	1.00	-1.24	1.00	1.12	1.00	0.70	1.00	1.24	1.00
Violent	-1.41	1.00	0.56	1.00	-3.09	0.48	1.68	1.00	3.65	0.33	3.09	0.48
Erotic	0.37	1.00	-1.20	1.00	-2.02	1.00	2.39	0.65	0.82	1.00	2.02	1.00

Disgust	-1.47	1.00	-1.39	1.00	-3.18	0.19	1.71	1.00	1.79	1.00	3.18	0.19
Cz												
Neutral	0.31	1.00	1.58	1.00	-0.33	1.00	0.64	1.00	1.91	0.57	0.33	1.00
Violent	0.69	1.00	5.00	0.02	0.84	1.00	-0.15	1.00	4.15	0.07	-0.84	1.00
Erotic	-0.42	1.00	1.01	1.00	-1.69	0.27	1.28	0.60	2.70	0.02	1.69	0.27
Disgust	0.23	1.00	2.86	0.27	-0.14	1.00	0.38	1.00	3.00	0.19	0.14	1.00
Pz												
Neutral	-0.08	1.00	2.57	0.25	-0.74	1.00	0.66	1.00	3.31	0.05	0.74	1.00
Violent	0.85	1.00	4.90	0.01	2.20	0.68	-1.35	1.00	2.70	0.43	-2.20	0.68
Erotic	-1.20	1.00	1.23	1.00	-2.41	0.44	1.20	1.00	3.64	0.08	2.41	0.44
Disgust	0.54	1.00	2.47	1.00	0.45	1.00	0.10	1.00	2.03	1.00	-0.45	1.00
ELPP												
Fz												
Neutral	-0.97	1.00	-2.03	1.00	-1.32	1.00	0.35	1.00	-0.71	1.00	1.32	1.00
Violent	-0.84	1.00	0.52	1.00	-0.66	1.00	-0.18	1.00	1.18	1.00	0.66	1.00
Erotic	-0.01	1.00	-2.52	1.00	-0.46	1.00	0.45	1.00	-2.06	1.00	0.46	1.00
Disgust	-0.95	1.00	-2.56	0.83	-2.33	0.83	1.38	1.00	-0.23	1.00	2.33	0.83
Fcz												
Neutral	-1.14	1.00	-1.76	1.00	-1.27	1.00	0.14	1.00	-0.48	1.00	1.27	1.00
Violent	-1.44	1.00	0.58	1.00	-1.31	1.00	-0.14	1.00	1.88	1.00	1.31	1.00

Erotic	-1.08	1.00	-2.14	1.00	-1.22	1.00	0.14	1.00	-0.92	1.00	1.22	1.00
Disgust	-1.33	1.00	-2.05	1.00	-2.81	0.36	1.48	1.00	0.76	1.00	2.81	0.36
Cz												
Neutral	-0.57	1.00	0.14	1.00	-0.97	1.00	0.40	1.00	1.11	1.00	0.97	1.00
Violent	1.01	1.00	4.73	0.04	1.74	1.00	-0.72	1.00	3.00	0.39	-1.74	1.00
Erotic	-2.46	0.11	0.34	1.00	-1.48	0.96	-0.98	1.00	1.82	0.65	1.48	0.96
Disgust	-0.58	1.00	1.11	1.00	0.16	1.00	-0.74	1.00	0.95	1.00	-0.16	1.00
Pz												
Neutral	0.14	1.00	1.89	0.54	-1.34	1.00	1.48	0.69	3.23	0.03	1.34	1.00
Violent	2.00	0.84	4.53	0.03	2.01	0.92	-0.01	1.00	2.52	0.59	-2.01	0.92
Erotic	-1.96	0.54	0.92	1.00	-3.89	0.01	1.92	0.53	4.81	0.00	3.89	0.01
Disgust	0.71	1.00	1.50	1.00	0.44	1.00	0.26	1.00	1.06	1.00	-0.44	1.00
LLPP												
Fz												
Neutral	-1.44	1.00	-2.66	0.40	-1.60	1.00	0.16	1.00	-1.07	1.00	1.60	1.00
Violent	-0.15	1.00	0.14	1.00	0.30	1.00	-0.45	1.00	-0.16	1.00	-0.30	1.00
Erotic	-0.90	1.00	-4.12	0.39	-2.64	1.00	1.74	1.00	-1.48	1.00	2.64	1.00
Disgust	-3.12	0.05	-2.74	0.24	-3.02	0.09	-0.10	1.00	0.27	1.00	3.02	0.09
Fcz												
Neutral	-1.29	1.00	-2.02	0.47	-1.37	1.00	0.08	1.00	-0.65	1.00	1.37	1.00

Violent	-0.59	1.00	-0.13	1.00	-0.40	1.00	-0.18	1.00	0.27	1.00	0.40	1.00
Erotic	-1.56	1.00	-3.48	0.31	-3.03	0.38	1.47	1.00	-0.45	1.00	3.03	0.38
Disgust	-2.58	0.09	-2.13	0.44	-2.97	0.05	0.39	1.00	0.84	1.00	2.97	0.05
Cz												
Neutral	-0.69	1.00	-0.17	1.00	-1.06	0.58	0.37	1.00	0.89	1.00	1.06	0.58
Violent	1.90	0.84	3.49	0.12	2.18	0.63	-0.28	1.00	1.31	1.00	-2.18	0.63
Erotic	-2.50	0.04	-0.86	1.00	-2.29	0.09	-0.21	1.00	1.44	0.84	2.29	0.09
Disgust	-0.18	1.00	0.83	1.00	-0.02	1.00	-0.17	1.00	0.84	1.00	0.02	1.00
Pz												
Neutral	0.15	1.00	1.81	0.48	-1.01	1.00	1.16	1.00	2.82	0.04	1.01	1.00
Violent	2.39	0.34	3.92	0.05	2.38	0.41	0.02	1.00	1.55	1.00	-2.38	0.41
Erotic	-2.07	0.16	-0.01	1.00	-3.92	0.00	1.85	0.25	3.92	0.00	3.92	0.00
Disgust	0.95	1.00	1.20	1.00	0.87	1.00	0.07	1.00	0.33	1.00	-0.87	1.00
	Low Agg Female						Low Agg Males					
Region and Image	Low Agg Male		High Agg Male		High Agg Female		Low Agg Female		High Agg Male		High Agg Female	
	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P
100ms												
Fz												

Neutral	-0.33	1.00	-1.78	0.37	0.04	1.00	0.33	1.00	-1.45	1.00	0.37	1.00
Violent	0.64	1.00	0.46	1.00	0.99	0.89	-0.64	1.00	-0.18	1.00	0.35	1.00
Erotic	1.69	0.64	1.10	1.00	0.01	1.00	-1.69	0.64	-0.58	1.00	-1.68	0.78
Disgust	-1.12	0.76	-1.67	0.08	-0.72	1.00	1.12	0.76	-0.56	1.00	0.40	1.00
Fcz												
Neutral	0.07	1.00	-1.17	0.66	0.32	1.00	-0.07	1.00	-1.23	0.85	0.25	1.00
Violent	0.97	0.86	0.51	1.00	1.34	0.20	-0.97	0.86	-0.46	1.00	0.37	1.00
Erotic	1.65	0.29	0.89	1.00	0.64	1.00	-1.65	0.29	-0.76	1.00	-1.00	1.00
Disgust	-0.48	1.00	-1.13	0.35	0.05	1.00	0.48	1.00	-0.64	1.00	0.53	1.00
Cz												
Neutral	1.28	0.29	0.73	1.00	-0.04	1.00	-1.28	0.29	-0.55	1.00	-1.32	0.32
Violent	1.31	0.37	0.47	1.00	0.00	1.00	-1.31	0.37	-0.84	1.00	-1.31	0.47
Erotic	0.94	0.41	0.57	1.00	0.43	1.00	-0.94	0.41	-0.37	1.00	-0.52	1.00
Disgust	1.23	0.09	-0.18	1.00	-0.01	1.00	-1.23	0.09	-1.41	0.04	-1.24	0.12
Pz												
Neutral	1.57	0.87	0.96	1.00	-0.18	1.00	-1.57	0.87	-0.61	1.00	-1.75	0.75
Violent	0.99	1.00	0.65	1.00	-0.51	1.00	-0.99	1.00	-0.34	1.00	-1.50	0.57
Erotic	0.95	1.00	-0.04	1.00	0.90	1.00	-0.95	1.00	-0.99	1.00	-0.04	1.00
Disgust	1.09	1.00	-0.04	1.00	-0.29	1.00	-1.09	1.00	-1.13	1.00	-1.38	1.00
200ms												

Fz												
Neutral	-1.12	1.00	-3.67	0.04	-0.03	1.00	1.12	1.00	-2.55	0.51	1.10	1.00
Violent	1.74	1.00	-2.27	0.47	1.00	1.00	-1.74	1.00	-4.01	0.05	-0.74	1.00
Erotic	1.13	1.00	-2.31	0.83	-1.00	1.00	-1.13	1.00	-3.44	0.35	-2.13	1.00
Disgust	-0.37	1.00	-3.52	0.03	-0.69	1.00	0.37	1.00	-3.15	0.16	-0.32	1.00
Fcz												
Neutral	-0.33	1.00	-2.54	0.12	0.35	1.00	0.33	1.00	-2.20	0.45	0.68	1.00
Violent	2.14	0.41	-1.97	0.37	1.47	1.00	-2.14	0.41	-4.10	0.01	-0.66	1.00
Erotic	1.11	1.00	-2.54	0.26	-0.50	1.00	-1.11	1.00	-3.65	0.08	-1.61	1.00
Disgust	0.09	1.00	-2.71	0.13	-0.02	1.00	-0.09	1.00	-2.81	0.22	-0.12	1.00
Cz												
Neutral	1.41	1.00	1.08	1.00	-0.01	1.00	-1.41	1.00	-0.33	1.00	-1.42	1.00
Violent	2.84	0.21	0.57	1.00	-0.41	1.00	-2.84	0.21	-2.27	0.59	-3.25	0.14
Erotic	0.79	1.00	-1.75	0.17	-0.17	1.00	-0.79	1.00	-2.54	0.04	-0.96	1.00
Disgust	0.78	1.00	-0.59	1.00	-0.95	1.00	-0.78	1.00	-1.38	1.00	-1.74	0.73
Pz												
Neutral	2.15	0.73	2.24	0.45	-0.12	1.00	-2.15	0.73	0.09	1.00	-2.27	0.74
Violent	2.15	0.72	2.63	0.23	-0.76	1.00	-2.15	0.72	0.48	1.00	-2.91	0.30
Erotic	1.09	1.00	0.26	1.00	1.00	1.00	-1.09	1.00	-0.83	1.00	-0.09	1.00
Disgust	-0.34	1.00	1.42	1.00	-1.43	1.00	0.34	1.00	1.77	1.00	-1.09	1.00

300ms												
Fz												
Neutral	-1.05	1.00	-1.34	1.00	-0.28	1.00	1.05	1.00	-0.29	1.00	0.78	1.00
Violent	1.33	1.00	-1.65	1.00	0.79	1.00	-1.33	1.00	-2.98	1.00	-0.54	1.00
Erotic	-2.40	1.00	-2.18	1.00	-0.95	1.00	2.40	1.00	0.22	1.00	1.44	1.00
Disgust	-0.87	1.00	-1.70	1.00	1.01	1.00	0.87	1.00	-0.83	1.00	1.88	1.00
Fcz												
Neutral	-0.42	1.00	-1.12	1.00	0.12	1.00	0.42	1.00	-0.70	1.00	0.54	1.00
Violent	1.97	1.00	-1.68	1.00	1.41	1.00	-1.97	1.00	-3.65	0.33	-0.56	1.00
Erotic	-1.56	1.00	-2.39	0.65	-0.37	1.00	1.56	1.00	-0.82	1.00	1.20	1.00
Disgust	0.08	1.00	-1.71	1.00	1.47	1.00	-0.08	1.00	-1.79	1.00	1.39	1.00
Cz												
Neutral	1.27	1.00	-0.64	1.00	-0.31	1.00	-1.27	1.00	-1.91	0.57	-1.58	1.00
Violent	4.30	0.04	0.15	1.00	-0.69	1.00	-4.30	0.04	-4.15	0.07	-5.00	0.02
Erotic	1.42	0.60	-1.28	0.60	0.42	1.00	-1.42	0.60	-2.70	0.02	-1.01	1.00
Disgust	2.63	0.31	-0.38	1.00	-0.23	1.00	-2.63	0.31	-3.00	0.19	-2.86	0.27
Pz												
Neutral	2.65	0.16	-0.66	1.00	0.08	1.00	-2.65	0.16	-3.31	0.05	-2.57	0.25
Violent	4.05	0.04	1.35	1.00	-0.85	1.00	-4.05	0.04	-2.70	0.43	-4.90	0.01
Erotic	2.43	0.49	-1.20	1.00	1.20	1.00	-2.43	0.49	-3.64	0.08	-1.23	1.00

Disgust	1.93	1.00	-0.10	1.00	-0.54	1.00	-1.93	1.00	-2.03	1.00	-2.47	1.00
ELPP												
Fz												
Neutral	-1.06	1.00	-0.35	1.00	0.97	1.00	1.06	1.00	0.71	1.00	2.03	1.00
Violent	1.36	1.00	0.18	1.00	0.84	1.00	-1.36	1.00	-1.18	1.00	-0.52	1.00
Erotic	-2.51	1.00	-0.45	1.00	0.01	1.00	2.51	1.00	2.06	1.00	2.52	1.00
Disgust	-1.61	1.00	-1.38	1.00	0.95	1.00	1.61	1.00	0.23	1.00	2.56	0.83
Fcz												
Neutral	-0.62	1.00	-0.14	1.00	1.14	1.00	0.62	1.00	0.48	1.00	1.76	1.00
Violent	2.02	1.00	0.14	1.00	1.44	1.00	-2.02	1.00	-1.88	1.00	-0.58	1.00
Erotic	-1.07	1.00	-0.14	1.00	1.08	1.00	1.07	1.00	0.92	1.00	2.14	1.00
Disgust	-0.72	1.00	-1.48	1.00	1.33	1.00	0.72	1.00	-0.76	1.00	2.05	1.00
Cz												
Neutral	0.71	1.00	-0.40	1.00	0.57	1.00	-0.71	1.00	-1.11	1.00	-0.14	1.00
Violent	3.72	0.12	0.72	1.00	-1.01	1.00	-3.72	0.12	-3.00	0.39	-4.73	0.04
Erotic	2.80	0.08	0.98	1.00	2.46	0.11	-2.80	0.08	-1.82	0.65	-0.34	1.00
Disgust	1.68	1.00	0.74	1.00	0.58	1.00	-1.68	1.00	-0.95	1.00	-1.11	1.00
Pz												
Neutral	1.74	0.58	-1.48	0.69	-0.14	1.00	-1.74	0.58	-3.23	0.03	-1.89	0.54
Violent	2.53	0.51	0.01	1.00	-2.00	0.84	-2.53	0.51	-2.52	0.59	-4.53	0.03

Erotic	2.88	0.14	-1.92	0.53	1.96	0.54	-2.88	0.14	-4.81	0.00	-0.92	1.00
Disgust	0.80	1.00	-0.26	1.00	-0.71	1.00	-0.80	1.00	-1.06	1.00	-1.50	1.00
LLPP												
Fz												
Neutral	-1.23	1.00	-0.16	1.00	1.44	1.00	1.23	1.00	1.07	1.00	2.66	0.40
Violent	0.29	1.00	0.45	1.00	0.15	1.00	-0.29	1.00	0.16	1.00	-0.14	1.00
Erotic	-3.22	0.74	-1.74	1.00	0.90	1.00	3.22	0.74	1.48	1.00	4.12	0.39
Disgust	0.38	1.00	0.10	1.00	3.12	0.05	-0.38	1.00	-0.27	1.00	2.74	0.24
Fcz												
Neutral	-0.73	1.00	-0.08	1.00	1.29	1.00	0.73	1.00	0.65	1.00	2.02	0.47
Violent	0.46	1.00	0.18	1.00	0.59	1.00	-0.46	1.00	-0.27	1.00	0.13	1.00
Erotic	-1.92	1.00	-1.47	1.00	1.56	1.00	1.92	1.00	0.45	1.00	3.48	0.31
Disgust	0.45	1.00	-0.39	1.00	2.58	0.09	-0.45	1.00	-0.84	1.00	2.13	0.44
Cz												
Neutral	0.52	1.00	-0.37	1.00	0.69	1.00	-0.52	1.00	-0.89	1.00	0.17	1.00
Violent	1.59	1.00	0.28	1.00	-1.90	0.84	-1.59	1.00	-1.31	1.00	-3.49	0.12
Erotic	1.65	0.49	0.21	1.00	2.50	0.04	-1.65	0.49	-1.44	0.84	0.86	1.00
Disgust	1.01	1.00	0.17	1.00	0.18	1.00	-1.01	1.00	-0.84	1.00	-0.83	1.00
Pz												
Neutral	1.65	0.54	-1.16	1.00	-0.15	1.00	-1.65	0.54	-2.82	0.04	-1.81	0.48

Violent	1.53	1.00	-0.02	1.00	-2.39	0.34	-1.53	1.00	-1.55	1.00	-3.92	0.05
Erotic	2.06	0.24	-1.85	0.25	2.07	0.16	-2.06	0.24	-3.91	0.00	0.01	1.00
Disgust	0.26	1.00	-0.07	1.00	-0.95	1.00	-0.26	1.00	-0.33	1.00	-1.20	1.00

*Highlighted values show significant results

Appendix S

Chapter 5 - Section 3: Trait Aggression (25th and 75th Percentile -Within Sex) Additional Data

Table of inferential statistics for Chapter 5.5.3 results. One-way independent groups ANOVA (two-tailed) results for mean ERP amplitude for males and females scoring high or low on the Buss and Perry (1992) Aggression Questionnaire, across the electrode site and epoch, in relation to image category. The results below relate to the analysis of a high and low total aggression scores for both males and females, that was defined by the weighted average by sex (i.e. males 25th percentile = 66; females 25th percentile =53; males 75th percentile =82; females 75th percentile=75).

High Agg Fems, High Agg Males, Low Agg Fems and Low Agg Males.					
Image category & Site	100	200	300	ELPP	LLPP
Fz					
Neutral	F(3,35) =1.75 p=0.18	F(3,35) =4.02 p=0.02	F(3,35) =0.89 p=0.46	F(3,35) =0.61 p=0.62	F(3,35) =1.62 p=0.2
Violent	F(3,35) =0.48 p=0.7	F(3,35) =4.06 p=0.01	F(3,35) =1.16 p=0.34	F(3,35) =0.1 p=0.96	F(3,35) =0.03 p=0.99
Erotic	F(3,35) =1.77 p=0.17	F(3,35) =1.52 p=0.23	F(3,35) =0.96 p=0.42	F(3,35) =0.51 p=0.68	F(3,35) =2.09 p=0.12
Disgust	F(3,35) =3.22 p=0.04	F(3,35) =4.44 p=0.01	F(3,35) =2.12 p=0.12	F(3,35) =1.15 p=0.34	F(3,35) =2.4 p=0.09

Fcz					
Neutral	F(3,35) =1.43 p=0.25	F(3,35) =2.92 p=0.05	F(3,35) =0.8 p=0.5	F(3,35) =0.51 p=0.68	F(3,35) =1.29 p=0.29
Violent	F(3,35) =1.18 p=0.33	F(3,35) =5.35 p<0.01	F(3,35) =1.48 p=0.24	F(3,35) =0.31 p=0.82	F(3,35) =0.06 p=0.98
Erotic	F(3,35) =2.06 p=0.13	F(3,35) =2.82 p=0.05	F(3,35) =1.45 p=0.25	F(3,35) =0.4 p=0.75	F(3,35) =2.25 p=0.1
Disgust	F(3,35) =1.51 p=0.23	F(3,35) =3.02 p=0.04	F(3,35) =1.96 p=0.14	F(3,35) =0.94 p=0.43	F(3,35) =2.01 p=0.13
Cz					
Neutral	F(3,35) =4.32 p=0.01	F(3,35) =1.38 p=0.27	F(3,35) =0.61 p=0.62	F(3,35) =0.34 p=0.8	F(3,35) =1.8 p=0.17
Violent	F(3,35) =1.82 p=0.16	F(3,35) =2.39 p=0.09	F(3,35) =3.44 p=0.03	F(3,35) =2.6 p=0.07	F(3,35) =2.15 p=0.11
Erotic	F(3,35) =1.97 p=0.14	F(3,35) =2.26 p=0.1	F(3,35) =2.46 p=0.08	F(3,35) =1.78 p=0.17	F(3,35) =1.9 p=0.15
Disgust	F(3,35) =3.05 p=0.04	F(3,35) =0.94 p=0.43	F(3,35) =1.57 p=0.22	F(3,35) =0.56 p=0.64	F(3,35) =0.49 p=0.69
Pz					
Neutral	F(3,35) =2.43 p=0.08	F(3,35) =4.22 p=0.01	F(3,35) =2.66 p=0.06	F(3,35) =1.48 p=0.24	F(3,35) =1.15 p=0.35
Violent	F(3,35) =2.15 p=0.11	F(3,35) =3.81 p=0.02	F(3,35) =6.28 p<0.01	F(3,35) =3.41 p=0.03	F(3,35) =3.33 p=0.03

Erotic	$F(3,35) = 1.11$ $p=0.36$	$F(3,35) = 0.88$ $p=0.46$	$F(3,35) = 2.3$ $p=0.1$	$F(3,35) = 5.84$ $p<0.01$	$F(3,35) = 6.02$ $p<0.01$
Disgust	$F(3,35) = 0.78$ $p=0.51$	$F(3,35) = 3.28$ $p=0.03$	$F(3,35) = 3$ $p=0.05$	$F(3,35) = 1.23$ $p=0.31$	$F(3,35) = 1.43$ $p=0.25$

*Highlighted values show significant results

Appendix T

Chapter 5- Section 3: Trait Aggression (25th and 75th Percentile --Within Sex) Post Hoc Tests

Table of Bonferroni Post Hoc Test results to show which groups differ for the ANOVAs (Appendix S).

	High Agg Female						High Agg Males					
Region and Image	Low Agg Female		Low Agg Male		High Agg Male		Low Agg Female		Low Agg Male		High Agg Female	
	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P
100ms												
Fz												
Neutral	0.10	1.00	-0.77	1.00	-2.04	0.35	2.14	0.29	1.27	1.00	2.04	0.35
Violent	-0.71	1.00	-0.74	1.00	-0.64	1.00	-0.07	1.00	-0.10	1.00	0.64	1.00
Erotic	0.12	1.00	1.71	0.55	1.60	0.68	-1.48	0.84	0.11	1.00	-1.60	0.68
Disgust	0.88	1.00	-0.50	1.00	-1.19	0.57	2.07	0.03	0.69	1.00	1.19	0.57
Fcz												
Neutral	-0.19	1.00	-0.43	1.00	-1.54	0.37	1.35	0.60	1.10	1.00	1.54	0.37
Violent	-1.09	0.51	-0.57	1.00	-0.88	1.00	-0.21	1.00	0.31	1.00	0.88	1.00
Erotic	-0.55	1.00	1.36	0.63	0.68	1.00	-1.23	0.85	0.68	1.00	-0.68	1.00
Disgust	0.23	1.00	-0.12	1.00	-1.09	0.64	1.32	0.31	0.96	1.00	1.09	0.64
Cz												

Neutral	-0.37	1.00	1.42	0.12	1.06	0.45	-1.43	0.11	0.35	1.00	-1.06	0.45
Violent	-0.21	1.00	1.37	0.40	0.29	1.00	-0.50	1.00	1.08	0.99	-0.29	1.00
Erotic	-0.47	1.00	0.64	1.00	0.40	1.00	-0.88	0.52	0.24	1.00	-0.40	1.00
Disgust	-0.19	1.00	1.07	0.13	0.17	1.00	-0.36	1.00	0.90	0.38	-0.17	1.00
Pz												
Neutral	-0.04	1.00	2.44	0.20	1.55	1.00	-1.59	0.94	0.89	1.00	-1.55	1.00
Violent	0.21	1.00	2.47	0.16	0.93	1.00	-0.73	1.00	1.54	1.00	-0.93	1.00
Erotic	-0.81	1.00	0.59	1.00	-0.60	1.00	-0.20	1.00	1.19	1.00	0.60	1.00
Disgust	-0.08	1.00	0.84	1.00	1.04	1.00	-1.12	1.00	-0.20	1.00	-1.04	1.00
200ms												
Fz												
Neutral	0.62	1.00	-1.57	1.00	-3.75	0.06	4.37	0.02	2.18	0.83	3.75	0.06
Violent	-0.54	1.00	-0.24	1.00	-4.22	0.02	3.68	0.06	3.98	0.05	4.22	0.02
Erotic	1.46	1.00	1.93	1.00	-1.34	1.00	2.79	0.60	3.27	0.41	1.34	1.00
Disgust	1.18	1.00	-0.15	1.00	-3.18	0.08	4.37	0.01	3.03	0.15	3.18	0.08
Fcz												
Neutral	0.17	1.00	-1.00	1.00	-2.83	0.10	3.00	0.07	1.83	0.78	2.83	0.10
Violent	-0.99	1.00	-0.23	1.00	-4.13	0.01	3.14	0.05	3.90	0.02	4.13	0.01
Erotic	0.86	1.00	1.87	1.00	-2.06	0.81	2.92	0.23	3.93	0.06	2.06	0.81
Disgust	0.65	1.00	0.09	1.00	-2.61	0.18	3.26	0.05	2.69	0.20	2.61	0.18

Cz												
Neutral	-0.38	1.00	1.04	1.00	1.40	1.00	-1.78	0.53	-0.37	1.00	-1.40	1.00
Violent	0.56	1.00	3.34	0.10	1.00	1.00	-0.44	1.00	2.34	0.61	-1.00	1.00
Erotic	0.31	1.00	0.71	1.00	-1.50	0.56	1.80	0.27	2.21	0.13	1.50	0.56
Disgust	0.71	1.00	1.66	0.63	0.88	1.00	-0.18	1.00	0.78	1.00	-0.88	1.00
Pz												
Neutral	-0.57	1.00	2.75	0.23	3.01	0.14	-3.58	0.05	-0.26	1.00	-3.01	0.14
Violent	0.63	1.00	4.39	0.06	3.86	0.14	-3.23	0.32	0.53	1.00	-3.86	0.14
Erotic	-0.98	1.00	0.90	1.00	-0.09	1.00	-0.89	1.00	0.99	1.00	0.09	1.00
Disgust	0.45	1.00	1.60	1.00	4.08	0.04	-3.64	0.09	-2.48	0.62	-4.08	0.04
300ms												
Fz												
Neutral	0.60	1.00	-0.89	1.00	-1.63	1.00	2.23	0.83	0.74	1.00	1.63	1.00
Violent	-0.03	1.00	0.12	1.00	-3.28	0.77	3.25	0.79	3.40	0.81	3.28	0.77
Erotic	0.83	1.00	-1.63	1.00	-2.34	1.00	3.17	0.85	0.71	1.00	2.34	1.00
Disgust	-0.24	1.00	-2.10	1.00	-3.28	0.22	3.04	0.32	1.19	1.00	3.28	0.22
Fcz												
Neutral	0.35	1.00	-0.40	1.00	-1.45	1.00	1.80	0.89	1.05	1.00	1.45	1.00
Violent	-0.65	1.00	-0.27	1.00	-3.57	0.38	2.92	0.76	3.30	0.62	3.57	0.38
Erotic	0.32	1.00	-0.97	1.00	-2.74	0.57	3.06	0.38	1.77	1.00	2.74	0.57

Disgust	-0.63	1.00	-1.27	1.00	-3.24	0.16	2.61	0.43	1.97	1.00	3.24	0.16
Cz												
Neutral	0.15	1.00	1.16	1.00	-0.34	1.00	0.49	1.00	1.50	1.00	0.34	1.00
Violent	0.53	1.00	4.59	0.04	0.83	1.00	-0.31	1.00	3.75	0.17	-0.83	1.00
Erotic	-0.54	1.00	0.53	1.00	-1.89	0.26	1.35	0.86	2.43	0.09	1.89	0.26
Disgust	-0.11	1.00	2.41	0.43	0.42	1.00	-0.54	1.00	1.99	0.93	-0.42	1.00
Pz												
Neutral	-0.50	1.00	2.36	0.25	-0.30	1.00	-0.21	1.00	2.65	0.18	0.30	1.00
Violent	0.20	1.00	6.05	0.00	2.66	0.60	-2.46	0.76	3.39	0.29	-2.66	0.60
Erotic	-1.61	1.00	1.31	1.00	-1.77	1.00	0.17	1.00	3.08	0.21	1.77	1.00
Disgust	-0.73	1.00	2.99	0.22	1.69	1.00	-2.42	0.51	1.29	1.00	-1.69	1.00
ELPP												
Fz												
Neutral	-1.19	1.00	-1.93	1.00	-1.57	1.00	0.38	1.00	-0.36	1.00	1.57	1.00
Violent	-0.28	1.00	0.57	1.00	-0.46	1.00	0.18	1.00	1.03	1.00	0.46	1.00
Erotic	-0.95	1.00	-3.14	1.00	-0.19	1.00	-0.76	1.00	-2.95	1.00	0.19	1.00
Disgust	-0.92	1.00	-2.78	0.60	-2.14	1.00	1.23	1.00	-0.64	1.00	2.14	1.00
Fcz												
Neutral	-1.08	1.00	-1.32	1.00	-1.24	1.00	0.16	1.00	-0.08	1.00	1.24	1.00
Violent	-0.89	1.00	0.33	1.00	-1.03	1.00	0.14	1.00	1.36	1.00	1.03	1.00

Erotic	-1.75	1.00	-2.24	1.00	-0.66	1.00	-1.09	1.00	-1.58	1.00	0.66	1.00
Disgust	-1.04	1.00	-1.93	1.00	-2.35	0.81	1.31	1.00	0.42	1.00	2.35	0.81
Cz												
Neutral	-0.39	1.00	-0.43	1.00	-0.97	1.00	0.59	1.00	0.54	1.00	0.97	1.00
Violent	0.87	1.00	4.22	0.07	1.67	1.00	-0.79	1.00	2.55	0.80	-1.67	1.00
Erotic	-2.42	0.21	-0.51	1.00	-1.15	1.00	-1.27	1.00	0.64	1.00	1.15	1.00
Disgust	-0.66	1.00	0.47	1.00	0.87	1.00	-1.53	1.00	-0.40	1.00	-0.87	1.00
Pz												
Neutral	0.34	1.00	1.25	1.00	-1.33	1.00	1.67	1.00	2.58	0.28	1.33	1.00
Violent	1.45	1.00	4.77	0.02	1.81	1.00	-0.36	1.00	2.96	0.44	-1.81	1.00
Erotic	-2.13	0.46	0.98	1.00	-3.88	0.02	1.75	0.99	4.86	0.00	3.88	0.02
Disgust	-0.27	1.00	1.88	0.87	1.06	1.00	-1.33	1.00	0.82	1.00	-1.06	1.00
LLPP												
Fz												
Neutral	-1.59	1.00	-2.39	0.41	-2.35	0.44	0.76	1.00	-0.04	1.00	2.35	0.44
Violent	0.18	1.00	0.38	1.00	-0.06	1.00	0.24	1.00	0.43	1.00	0.06	1.00
Erotic	-1.66	1.00	-5.27	0.12	-2.53	1.00	0.87	1.00	-2.74	1.00	2.53	1.00
Disgust	-2.83	0.15	-2.73	0.25	-2.47	0.38	-0.36	1.00	-0.25	1.00	2.47	0.38
Fcz												
Neutral	-1.26	1.00	-1.64	0.74	-1.79	0.56	0.53	1.00	0.15	1.00	1.79	0.56

Violent	-0.21	1.00	-0.13	1.00	-0.53	1.00	0.31	1.00	0.39	1.00	0.53	1.00
Erotic	-2.10	1.00	-4.25	0.09	-2.65	0.73	0.55	1.00	-1.60	1.00	2.65	0.73
Disgust	-2.23	0.25	-1.79	0.71	-2.28	0.29	0.06	1.00	0.49	1.00	2.28	0.29
Cz												
Neutral	-0.57	1.00	-0.52	1.00	-1.49	0.16	0.92	0.98	0.97	0.98	1.49	0.16
Violent	1.83	1.00	3.57	0.10	1.98	1.00	-0.14	1.00	1.60	1.00	-1.98	1.00
Erotic	-2.21	0.20	-1.68	0.73	-1.82	0.57	-0.40	1.00	0.14	1.00	1.82	0.57
Disgust	-0.37	1.00	0.59	1.00	0.60	1.00	-0.98	1.00	-0.02	1.00	-0.60	1.00
Pz												
Neutral	0.33	1.00	0.98	1.00	-1.15	1.00	1.48	1.00	2.13	0.49	1.15	1.00
Violent	2.26	0.64	4.54	0.02	2.33	0.69	-0.08	1.00	2.20	0.94	-2.33	0.69
Erotic	-1.88	0.35	0.42	1.00	-3.51	0.01	1.63	0.71	3.93	0.01	3.51	0.01
Disgust	0.25	1.00	1.82	0.63	1.59	0.94	-1.34	1.00	0.23	1.00	-1.59	0.94
	Low Agg Female						Low Agg Males					
Region and Image	Low Agg Male		High Agg Male		High Agg Female		Low Agg Female		High Agg Male		High Agg Female	
	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P
100ms												
Fz												

Neutral	-0.87	1.00	-2.14	0.29	-0.10	1.00	0.87	1.00	-1.27	1.00	0.77	1.00
Violent	-0.03	1.00	0.07	1.00	0.71	1.00	0.03	1.00	0.10	1.00	0.74	1.00
Erotic	1.59	0.68	1.48	0.84	-0.12	1.00	-1.59	0.68	-0.11	1.00	-1.71	0.55
Disgust	-1.38	0.32	-2.07	0.03	-0.88	1.00	1.38	0.32	-0.69	1.00	0.50	1.00
Fcz												
Neutral	-0.24	1.00	-1.35	0.60	0.19	1.00	0.24	1.00	-1.10	1.00	0.43	1.00
Violent	0.52	1.00	0.21	1.00	1.09	0.51	-0.52	1.00	-0.31	1.00	0.57	1.00
Erotic	1.91	0.15	1.23	0.85	0.55	1.00	-1.91	0.15	-0.68	1.00	-1.36	0.63
Disgust	-0.35	1.00	-1.32	0.31	-0.23	1.00	0.35	1.00	-0.96	1.00	0.12	1.00
Cz												
Neutral	1.79	0.02	1.43	0.11	0.37	1.00	-1.79	0.02	-0.35	1.00	-1.42	0.12
Violent	1.58	0.21	0.50	1.00	0.21	1.00	-1.58	0.21	-1.08	0.99	-1.37	0.40
Erotic	1.12	0.19	0.88	0.52	0.47	1.00	-1.12	0.19	-0.24	1.00	-0.64	1.00
Disgust	1.26	0.05	0.36	1.00	0.19	1.00	-1.26	0.05	-0.90	0.38	-1.07	0.13
Pz												
Neutral	2.48	0.19	1.59	0.94	0.04	1.00	-2.48	0.19	-0.89	1.00	-2.44	0.20
Violent	2.26	0.25	0.73	1.00	-0.21	1.00	-2.26	0.25	-1.54	1.00	-2.47	0.16
Erotic	1.39	0.63	0.20	1.00	0.81	1.00	-1.39	0.63	-1.19	1.00	-0.59	1.00
Disgust	0.91	1.00	1.12	1.00	0.08	1.00	-0.91	1.00	0.20	1.00	-0.84	1.00
200ms												

Fz												
Neutral	-2.19	0.71	-4.37	0.02	-0.62	1.00	2.19	0.71	-2.18	0.83	1.57	1.00
Violent	0.30	1.00	-3.68	0.06	0.54	1.00	-0.30	1.00	-3.98	0.05	0.24	1.00
Erotic	0.47	1.00	-2.79	0.60	-1.46	1.00	-0.47	1.00	-3.27	0.41	-1.93	1.00
Disgust	-1.34	1.00	-4.37	0.01	-1.18	1.00	1.34	1.00	-3.03	0.15	0.15	1.00
Fcz												
Neutral	-1.16	1.00	-3.00	0.07	-0.17	1.00	1.16	1.00	-1.83	0.78	1.00	1.00
Violent	0.77	1.00	-3.14	0.05	0.99	1.00	-0.77	1.00	-3.90	0.02	0.23	1.00
Erotic	1.01	1.00	-2.92	0.23	-0.86	1.00	-1.01	1.00	-3.93	0.06	-1.87	1.00
Disgust	-0.56	1.00	-3.26	0.05	-0.65	1.00	0.56	1.00	-2.69	0.20	-0.09	1.00
Cz												
Neutral	1.42	1.00	1.78	0.53	0.38	1.00	-1.42	1.00	0.37	1.00	-1.04	1.00
Violent	2.78	0.26	0.44	1.00	-0.56	1.00	-2.78	0.26	-2.34	0.61	-3.34	0.10
Erotic	0.40	1.00	-1.80	0.27	-0.31	1.00	-0.40	1.00	-2.21	0.13	-0.71	1.00
Disgust	0.96	1.00	0.18	1.00	-0.71	1.00	-0.96	1.00	-0.78	1.00	-1.66	0.63
Pz												
Neutral	3.32	0.08	3.58	0.05	0.57	1.00	-3.32	0.08	0.26	1.00	-2.75	0.23
Violent	3.76	0.16	3.23	0.32	-0.63	1.00	-3.76	0.16	-0.53	1.00	-4.39	0.06
Erotic	1.88	0.69	0.89	1.00	0.98	1.00	-1.88	0.69	-0.99	1.00	-0.90	1.00
Disgust	1.15	1.00	3.64	0.09	-0.45	1.00	-1.15	1.00	2.48	0.62	-1.60	1.00

300ms											
Fz											
Neutral	-1.49	1.00	-2.23	0.83	-0.60	1.00	1.49	1.00	-0.74	1.00	0.89	1.00
Violent	0.15	1.00	-3.25	0.79	0.03	1.00	-0.15	1.00	-3.40	0.81	-0.12	1.00
Erotic	-2.46	1.00	-3.17	0.85	-0.83	1.00	2.46	1.00	-0.71	1.00	1.63	1.00
Disgust	-1.86	1.00	-3.04	0.32	0.24	1.00	1.86	1.00	-1.19	1.00	2.10	1.00
Fcz												
Neutral	-0.75	1.00	-1.80	0.89	-0.35	1.00	0.75	1.00	-1.05	1.00	0.40	1.00
Violent	0.37	1.00	-2.92	0.76	0.65	1.00	-0.37	1.00	-3.30	0.62	0.27	1.00
Erotic	-1.30	1.00	-3.06	0.38	-0.32	1.00	1.30	1.00	-1.77	1.00	0.97	1.00
Disgust	-0.64	1.00	-2.61	0.43	0.63	1.00	0.64	1.00	-1.97	1.00	1.27	1.00
Cz												
Neutral	1.01	1.00	-0.49	1.00	-0.15	1.00	-1.01	1.00	-1.50	1.00	-1.16	1.00
Violent	4.06	0.08	0.31	1.00	-0.53	1.00	-4.06	0.08	-3.75	0.17	-4.59	0.04
Erotic	1.08	1.00	-1.35	0.86	0.54	1.00	-1.08	1.00	-2.43	0.09	-0.53	1.00
Disgust	2.53	0.36	0.54	1.00	0.11	1.00	-2.53	0.36	-1.99	0.93	-2.41	0.43
Pz												
Neutral	2.86	0.09	0.21	1.00	0.50	1.00	-2.86	0.09	-2.65	0.18	-2.36	0.25
Violent	5.85	0.00	2.46	0.76	-0.20	1.00	-5.85	0.00	-3.39	0.29	-6.05	0.00
Erotic	2.92	0.21	-0.17	1.00	1.61	1.00	-2.92	0.21	-3.08	0.21	-1.31	1.00

Disgust	3.71	0.06	2.42	0.51	0.73	1.00	-3.71	0.06	-1.29	1.00	-2.99	0.22
ELPP												
Fz												
Neutral	-0.74	1.00	-0.38	1.00	1.19	1.00	0.74	1.00	0.36	1.00	1.93	1.00
Violent	0.85	1.00	-0.18	1.00	0.28	1.00	-0.85	1.00	-1.03	1.00	-0.57	1.00
Erotic	-2.19	1.00	0.76	1.00	0.95	1.00	2.19	1.00	2.95	1.00	3.14	1.00
Disgust	-1.86	1.00	-1.23	1.00	0.92	1.00	1.86	1.00	0.64	1.00	2.78	0.60
Fcz												
Neutral	-0.24	1.00	-0.16	1.00	1.08	1.00	0.24	1.00	0.08	1.00	1.32	1.00
Violent	1.22	1.00	-0.14	1.00	0.89	1.00	-1.22	1.00	-1.36	1.00	-0.33	1.00
Erotic	-0.49	1.00	1.09	1.00	1.75	1.00	0.49	1.00	1.58	1.00	2.24	1.00
Disgust	-0.89	1.00	-1.31	1.00	1.04	1.00	0.89	1.00	-0.42	1.00	1.93	1.00
Cz												
Neutral	-0.05	1.00	-0.59	1.00	0.39	1.00	0.05	1.00	-0.54	1.00	0.43	1.00
Violent	3.34	0.25	0.79	1.00	-0.87	1.00	-3.34	0.25	-2.55	0.80	-4.22	0.07
Erotic	1.92	0.66	1.27	1.00	2.42	0.21	-1.92	0.66	-0.64	1.00	0.51	1.00
Disgust	1.13	1.00	1.53	1.00	0.66	1.00	-1.13	1.00	0.40	1.00	-0.47	1.00
Pz												
Neutral	0.91	1.00	-1.67	1.00	-0.34	1.00	-0.91	1.00	-2.58	0.28	-1.25	1.00
Violent	3.33	0.21	0.36	1.00	-1.45	1.00	-3.33	0.21	-2.96	0.44	-4.77	0.02

Erotic	3.11	0.10	-1.75	0.99	2.13	0.46	-3.11	0.10	-4.86	0.00	-0.98	1.00
Disgust	2.15	0.58	1.33	1.00	0.27	1.00	-2.15	0.58	-0.82	1.00	-1.88	0.87
LLPP												
Fz												
Neutral	-0.80	1.00	-0.76	1.00	1.59	1.00	0.80	1.00	0.04	1.00	2.39	0.41
Violent	0.19	1.00	-0.24	1.00	-0.18	1.00	-0.19	1.00	-0.43	1.00	-0.38	1.00
Erotic	-3.62	0.61	-0.87	1.00	1.66	1.00	3.62	0.61	2.74	1.00	5.27	0.12
Disgust	0.11	1.00	0.36	1.00	2.83	0.15	-0.11	1.00	0.25	1.00	2.73	0.25
Fcz												
Neutral	-0.38	1.00	-0.53	1.00	1.26	1.00	0.38	1.00	-0.15	1.00	1.64	0.74
Violent	0.08	1.00	-0.31	1.00	0.21	1.00	-0.08	1.00	-0.39	1.00	0.13	1.00
Erotic	-2.15	1.00	-0.55	1.00	2.10	1.00	2.15	1.00	1.60	1.00	4.25	0.09
Disgust	0.44	1.00	-0.06	1.00	2.23	0.25	-0.44	1.00	-0.49	1.00	1.79	0.71
Cz												
Neutral	0.05	1.00	-0.92	0.98	0.57	1.00	-0.05	1.00	-0.97	0.98	0.52	1.00
Violent	1.74	1.00	0.14	1.00	-1.83	1.00	-1.74	1.00	-1.60	1.00	-3.57	0.10
Erotic	0.54	1.00	0.40	1.00	2.21	0.20	-0.54	1.00	-0.14	1.00	1.68	0.73
Disgust	0.96	1.00	0.98	1.00	0.37	1.00	-0.96	1.00	0.02	1.00	-0.59	1.00
Pz												
Neutral	0.65	1.00	-1.48	1.00	-0.33	1.00	-0.65	1.00	-2.13	0.49	-0.98	1.00

Violent	2.28	0.74	0.08	1.00	-2.26	0.64	-2.28	0.74	-2.20	0.94	-4.54	0.02
Erotic	2.30	0.18	-1.63	0.71	1.88	0.35	-2.30	0.18	-3.93	0.01	-0.42	1.00
Disgust	1.57	0.96	1.34	1.00	-0.25	1.00	-1.57	0.96	-0.23	1.00	-1.82	0.63

*Highlighted values show significant results

Appendix U

Chapter 5 - Section 4: Trait Aggression (K-Clusters) Additional Data

Table of inferential statistics for Chapter 5.5.5 results. One-way independent groups ANOVA (two-tailed) results for mean ERP amplitude for males and females scoring high or low on the Buss and Perry (1992) Aggression Questionnaire, across the electrode site and epoch, in relation to image category. The results below relate to the analysis of a high and low total aggression score that was defined by automated cluster analysis.

High Agg Fems, High Agg Males, Low Agg Fems and Low Agg Males.					
Image category & Site	100	200	300	ELPP	LLPP
Fz					
Neutral	$F(3,77) = 2.07$ $p=0.11$	$F(3,77) = 2.29$ $p=0.09$	$F(3,77) = 0.48$ $p=0.7$	$F(3,77) = 0.86$ $p=0.47$	$F(3,77) = 0.97$ $p=0.41$
Violent	$F(3,77) = 0.92$ $p=0.44$	$F(3,77) = 1.68$ $p=0.18$	$F(3,77) = 0.34$ $p=0.8$	$F(3,77) = 0.88$ $p=0.46$	$F(3,77) = 1.41$ $p=0.25$
Erotic	$F(3,77) = 0.51$ $p=0.68$	$F(3,77) = 0.62$ $p=0.6$	$F(3,77) = 0.45$ $p=0.72$	$F(3,77) = 1.15$ $p=0.33$	$F(3,77) = 1.47$ $p=0.23$
Disgust	$F(3,77) = 2.49$ $p=0.07$	$F(3,77) = 1.85$ $p=0.15$	$F(3,77) = 0.35$ $p=0.79$	$F(3,77) = 0.74$ $p=0.53$	$F(3,77) = 0.5$ $p=0.69$
Fcz					

Neutral	F(3,77) =1.98 p=0.12	F(3,77) =1.86 p=0.14	F(3,77) =0.45 p=0.72	F(3,77) =0.66 p=0.58	F(3,77) =0.5 p=0.69
Violent	F(3,77) =1.59 p=0.2	F(3,77) =2.57 p=0.06	F(3,77) =0.59 p=0.62	F(3,77) =0.78 p=0.51	F(3,77) =0.77 p=0.52
Erotic	F(3,77) =0.8 p=0.5	F(3,77) =1.54 p=0.21	F(3,77) =0.56 p=0.64	F(3,77) =0.69 p=0.56	F(3,77) =0.97 p=0.41
Disgust	F(3,77) =1.91 p=0.14	F(3,77) =1.72 p=0.17	F(3,77) =0.81 p=0.49	F(3,77) =0.39 p=0.76	F(3,77) =0.35 p=0.79
Cz					
Neutral	F(3,77) =5.09 p=0	F(3,77) =3.67 p=0.02	F(3,77) =0.65 p=0.58	F(3,77) =0.38 p=0.77	F(3,77) =0.25 p=0.86
Violent	F(3,77) =2.73 p=0.05	F(3,77) =3.22 p=0.03	F(3,77) =3.89 p=0.01	F(3,77) =4.45 p=0.01	F(3,77) =2.32 p=0.08
Erotic	F(3,77) =2.98 p=0.04	F(3,77) =0.37 p=0.77	F(3,77) =0.66 p=0.58	F(3,77) =1.87 p=0.14	F(3,77) =0.9 p=0.45
Disgust	F(3,77) =0.7 p=0.56	F(3,77) =0.47 p=0.7	F(3,77) =1.56 p=0.21	F(3,77) =2.27 p=0.09	F(3,77) =1.28 p=0.29
Pz					
Neutral	F(3,77) =3.03 p=0.03	F(3,77) =4.73 p=0	F(3,77) =2.78 p=0.05	F(3,77) =1.38 p=0.26	F(3,77) =0.95 p=0.42
Violent	F(3,77) =4.73 p=0	F(3,77) =9.69 p=0	F(3,77) =8.28 p=0	F(3,77) =5.34 p=0	F(3,77) =3.16 p=0.03

Erotic	F(3,77) =1.62 p=0.19	F(3,77) =2.44 p=0.07	F(3,77) =1.87 p=0.14	F(3,77) =4.85 p=0	F(3,77) =4.6 p=0.01
Disgust	F(3,77) =0.45 p=0.72	F(3,77) =3.5 p=0.02	F(3,77) =2.45 p=0.07	F(3,77) =2.03 p=0.12	F(3,77) =2.06 p=0.11

Appendix V

Chapter 5 - Section 4: Trait Aggression (K-Clusters) Post Hoc Tests

Table of Bonferroni Post Hoc Test results to show which groups differ for the ANOVAs (Appendix U).

	High Agg Female						High Agg Males					
Region and Image	Low Agg Female		Low Agg Male		High Agg Male		Low Agg Female		Low Agg Male		High Agg Female	
	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P
100ms												
Fz												
Neutral	-0.47	1.00	-0.86	1.00	-1.38	0.10	0.91	0.93	0.52	1.00	1.38	0.10
Violent	-0.74	0.93	-0.62	1.00	-0.60	1.00	-0.14	1.00	-0.02	1.00	0.60	1.00
Erotic	0.22	1.00	1.15	1.00	0.36	1.00	-0.14	1.00	0.80	1.00	-0.36	1.00
Disgust	0.41	1.00	-0.68	1.00	-0.87	0.38	1.29	0.09	0.20	1.00	0.87	0.38
Fcz												
Neutral	-0.44	1.00	-0.37	1.00	-1.10	0.11	0.66	1.00	0.74	1.00	1.10	0.11
Violent	-0.83	0.44	-0.23	1.00	-0.73	0.45	-0.10	1.00	0.50	1.00	0.73	0.45
Erotic	-0.11	1.00	1.07	1.00	0.06	1.00	-0.17	1.00	1.01	1.00	-0.06	1.00
Disgust	0.12	1.00	-0.22	1.00	-0.85	0.29	0.96	0.27	0.62	1.00	0.85	0.29
Cz												

Neutral	0.51	1.00	1.59	0.01	1.14	0.01	-0.63	0.72	0.45	1.00	-1.14	0.01
Violent	0.32	1.00	1.49	0.04	0.59	0.80	-0.26	1.00	0.91	0.57	-0.59	0.80
Erotic	0.06	1.00	0.77	0.49	0.79	0.08	-0.73	0.24	-0.03	1.00	-0.79	0.08
Disgust	0.24	1.00	0.65	1.00	0.07	1.00	0.18	1.00	0.58	1.00	-0.07	1.00
Pz												
Neutral	0.61	1.00	2.17	0.08	1.42	0.14	-0.80	1.00	0.75	1.00	-1.42	0.14
Violent	0.91	0.76	2.47	0.01	1.44	0.04	-0.53	1.00	1.03	0.97	-1.44	0.04
Erotic	-0.35	1.00	1.01	1.00	0.72	1.00	-1.07	0.51	0.29	1.00	-0.72	1.00
Disgust	0.58	1.00	0.92	1.00	0.34	1.00	0.24	1.00	0.58	1.00	-0.34	1.00
200ms												
Fz												
Neutral	-1.45	0.98	-2.28	0.47	-2.22	0.11	0.77	1.00	-0.05	1.00	2.22	0.11
Violent	-1.98	0.45	-0.76	1.00	-1.91	0.33	-0.07	1.00	1.15	1.00	1.91	0.33
Erotic	0.10	1.00	1.24	1.00	-0.88	1.00	0.98	1.00	2.12	1.00	0.88	1.00
Disgust	-0.78	1.00	-1.22	1.00	-2.13	0.14	1.35	1.00	0.91	1.00	2.13	0.14
Fcz												
Neutral	-1.53	0.52	-1.55	0.96	-1.66	0.22	0.13	1.00	0.11	1.00	1.66	0.22
Violent	-2.12	0.18	-0.60	1.00	-2.03	0.12	-0.08	1.00	1.44	1.00	2.03	0.12
Erotic	-0.10	1.00	1.37	1.00	-1.33	1.00	1.24	1.00	2.70	0.29	1.33	1.00
Disgust	-1.03	1.00	-0.91	1.00	-1.93	0.16	0.90	1.00	1.03	1.00	1.93	0.16

Cz												
Neutral	0.00	1.00	1.17	1.00	2.00	0.03	-1.99	0.07	-0.83	1.00	-2.00	0.03
Violent	-0.20	1.00	2.55	0.18	1.77	0.21	-1.97	0.22	0.78	1.00	-1.77	0.21
Erotic	-0.30	1.00	0.65	1.00	-0.27	1.00	-0.03	1.00	0.92	1.00	0.27	1.00
Disgust	0.31	1.00	0.85	1.00	0.76	1.00	-0.45	1.00	0.09	1.00	-0.76	1.00
Pz												
Neutral	1.32	0.92	3.02	0.06	2.79	0.01	-1.46	0.69	0.24	1.00	-2.79	0.01
Violent	1.38	0.72	4.27	0.00	3.66	0.00	-2.28	0.07	0.61	1.00	-3.66	0.00
Erotic	-0.28	1.00	1.71	0.56	1.37	0.36	-1.65	0.27	0.33	1.00	-1.37	0.36
Disgust	1.92	0.29	1.79	0.81	2.68	0.01	-0.76	1.00	-0.89	1.00	-2.68	0.01
300ms												
Fz												
Neutral	-0.89	1.00	-1.22	1.00	-0.90	1.00	0.01	1.00	-0.32	1.00	0.90	1.00
Violent	-1.01	1.00	0.82	1.00	-0.39	1.00	-0.62	1.00	1.21	1.00	0.39	1.00
Erotic	1.55	1.00	-0.36	1.00	0.35	1.00	1.19	1.00	-0.72	1.00	-0.35	1.00
Disgust	-0.50	1.00	-1.13	1.00	-0.87	1.00	0.37	1.00	-0.26	1.00	0.87	1.00
Fcz												
Neutral	-0.84	1.00	-0.53	1.00	-0.84	1.00	0.00	1.00	0.31	1.00	0.84	1.00
Violent	-1.01	1.00	0.81	1.00	-0.94	1.00	-0.07	1.00	1.75	1.00	0.94	1.00
Erotic	1.26	1.00	0.33	1.00	-0.28	1.00	1.54	1.00	0.61	1.00	0.28	1.00

Disgust	-0.69	1.00	-0.49	1.00	-1.37	0.76	0.67	1.00	0.87	1.00	1.37	0.76
Cz												
Neutral	0.03	1.00	1.10	1.00	0.72	1.00	-0.69	1.00	0.39	1.00	-0.72	1.00
Violent	-0.02	1.00	3.97	0.01	1.29	0.95	-1.32	1.00	2.68	0.22	-1.29	0.95
Erotic	-0.24	1.00	1.08	1.00	-0.31	1.00	0.07	1.00	1.39	1.00	0.31	1.00
Disgust	0.01	1.00	2.11	0.26	0.29	1.00	-0.27	1.00	1.83	0.48	-0.29	1.00
Pz												
Neutral	0.87	1.00	2.86	0.03	1.08	0.84	-0.21	1.00	1.78	0.49	-1.08	0.84
Violent	1.16	1.00	5.75	0.00	2.18	0.08	-1.02	1.00	3.58	0.02	-2.18	0.08
Erotic	-0.87	1.00	2.14	0.52	-0.35	1.00	-0.52	1.00	2.49	0.28	0.35	1.00
Disgust	1.15	1.00	3.49	0.06	0.63	1.00	0.52	1.00	2.86	0.19	-0.63	1.00
ELPP												
Fz												
Neutral	-1.42	1.00	-1.44	1.00	-0.48	1.00	-0.94	1.00	-0.96	1.00	0.48	1.00
Violent	-0.56	1.00	1.38	1.00	1.16	1.00	-1.72	1.00	0.21	1.00	-1.16	1.00
Erotic	2.13	1.00	-0.34	1.00	2.70	0.71	-0.57	1.00	-3.04	1.00	-2.70	0.71
Disgust	-0.39	1.00	-1.12	1.00	1.02	1.00	-1.40	1.00	-2.13	1.00	-1.02	1.00
Fcz												
Neutral	-1.18	1.00	-0.66	1.00	-0.33	1.00	-0.85	1.00	-0.34	1.00	0.33	1.00
Violent	-0.62	1.00	1.48	1.00	0.53	1.00	-1.16	1.00	0.95	1.00	-0.53	1.00

Erotic	1.13	1.00	0.31	1.00	1.95	1.00	-0.82	1.00	-1.64	1.00	-1.95	1.00
Disgust	-0.54	1.00	-0.40	1.00	0.58	1.00	-1.12	1.00	-0.98	1.00	-0.58	1.00
Cz												
Neutral	-0.31	1.00	0.26	1.00	0.38	1.00	-0.69	1.00	-0.12	1.00	-0.38	1.00
Violent	0.09	1.00	3.83	0.01	0.94	1.00	-0.85	1.00	2.89	0.06	-0.94	1.00
Erotic	-1.15	1.00	1.13	1.00	0.61	1.00	-1.76	0.27	0.52	1.00	-0.61	1.00
Disgust	-0.15	1.00	1.50	0.80	1.43	0.28	-1.58	0.30	0.07	1.00	-1.43	0.28
Pz												
Neutral	0.83	1.00	1.75	0.40	0.20	1.00	0.64	1.00	1.55	0.62	-0.20	1.00
Violent	1.17	1.00	4.02	0.00	0.07	1.00	1.10	1.00	3.95	0.00	-0.07	1.00
Erotic	-1.83	0.39	1.38	1.00	-2.44	0.04	0.62	1.00	3.83	0.01	2.44	0.04
Disgust	1.27	1.00	2.65	0.17	0.27	1.00	1.00	1.00	2.38	0.29	-0.27	1.00
LLPP												
Fz												
Neutral	-1.16	1.00	-1.51	1.00	-0.25	1.00	-0.91	1.00	-1.26	1.00	0.25	1.00
Violent	0.20	1.00	1.65	1.00	1.58	0.51	-1.38	1.00	0.07	1.00	-1.58	0.51
Erotic	1.81	1.00	-1.84	1.00	1.79	1.00	0.02	1.00	-3.63	0.47	-1.79	1.00
Disgust	-0.95	1.00	-0.92	1.00	0.23	1.00	-1.19	1.00	-1.15	1.00	-0.23	1.00
Fcz												
Neutral	-0.79	1.00	-0.72	1.00	-0.09	1.00	-0.70	1.00	-0.63	1.00	0.09	1.00

Violent	-0.06	1.00	1.18	1.00	0.81	1.00	-0.88	1.00	0.37	1.00	-0.81	1.00
Erotic	1.16	1.00	-1.12	1.00	1.37	1.00	-0.20	1.00	-2.48	0.90	-1.37	1.00
Disgust	-0.92	1.00	-0.31	1.00	-0.18	1.00	-0.74	1.00	-0.13	1.00	0.18	1.00
Cz												
Neutral	-0.43	1.00	-0.01	1.00	-0.12	1.00	-0.31	1.00	0.11	1.00	0.12	1.00
Violent	0.37	1.00	2.48	0.07	0.82	1.00	-0.46	1.00	1.65	0.54	-0.82	1.00
Erotic	-0.86	1.00	-0.19	1.00	0.27	1.00	-1.12	0.67	-0.45	1.00	-0.27	1.00
Disgust	0.11	1.00	1.35	0.50	0.64	1.00	-0.53	1.00	0.71	1.00	-0.64	1.00
Pz												
Neutral	0.40	1.00	1.08	1.00	-0.21	1.00	0.61	1.00	1.29	0.72	0.21	1.00
Violent	1.12	1.00	2.94	0.03	0.33	1.00	0.79	1.00	2.61	0.07	-0.33	1.00
Erotic	-1.62	0.21	0.66	1.00	-1.96	0.03	0.34	1.00	2.62	0.04	1.96	0.03
Disgust	1.16	0.97	2.43	0.12	0.66	1.00	0.50	1.00	1.77	0.53	-0.66	1.00
	Low Agg Female						Low Agg Male					
Region and Image	Low Agg Male		High Agg Male		High Agg Female		Low Agg Female		High Agg Male		High Agg Female	
	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P	Mean Diff	P
100ms												
Fz												
Neutral	-0.39	1.00	-0.91	0.93	0.47	1.00	0.39	1.00	-0.52	1.00	0.86	1.00

Violent	0.12	1.00	0.14	1.00	0.74	0.93	-0.12	1.00	0.02	1.00	0.62	1.00
Erotic	0.93	1.00	0.14	1.00	-0.22	1.00	-0.93	1.00	-0.80	1.00	-1.15	1.00
Disgust	-1.09	0.70	-1.29	0.09	-0.41	1.00	1.09	0.70	-0.20	1.00	0.68	1.00
Fcz												
Neutral	0.07	1.00	-0.66	1.00	0.44	1.00	-0.07	1.00	-0.74	1.00	0.37	1.00
Violent	0.60	1.00	0.10	1.00	0.83	0.44	-0.60	1.00	-0.50	1.00	0.23	1.00
Erotic	1.18	0.92	0.17	1.00	0.11	1.00	-1.18	0.92	-1.01	1.00	-1.07	1.00
Disgust	-0.34	1.00	-0.96	0.27	-0.12	1.00	0.34	1.00	-0.62	1.00	0.22	1.00
Cz												
Neutral	1.08	0.27	0.63	0.72	-0.51	1.00	-1.08	0.27	-0.45	1.00	-1.59	0.01
Violent	1.17	0.27	0.26	1.00	-0.32	1.00	-1.17	0.27	-0.91	0.57	-1.49	0.04
Erotic	0.71	0.79	0.73	0.24	-0.06	1.00	-0.71	0.79	0.03	1.00	-0.77	0.49
Disgust	0.41	1.00	-0.18	1.00	-0.24	1.00	-0.41	1.00	-0.58	1.00	-0.65	1.00
Pz												
Neutral	1.55	0.54	0.80	1.00	-0.61	1.00	-1.55	0.54	-0.75	1.00	-2.17	0.08
Violent	1.56	0.29	0.53	1.00	-0.91	0.76	-1.56	0.29	-1.03	0.97	-2.47	0.01
Erotic	1.36	0.58	1.07	0.51	0.35	1.00	-1.36	0.58	-0.29	1.00	-1.01	1.00
Disgust	0.34	1.00	-0.24	1.00	-0.58	1.00	-0.34	1.00	-0.58	1.00	-0.92	1.00
200ms												
Fz												

Neutral	-0.83	1.00	-0.77	1.00	1.45	0.98	0.83	1.00	0.05	1.00	2.28	0.47
Violent	1.22	1.00	0.07	1.00	1.98	0.45	-1.22	1.00	-1.15	1.00	0.76	1.00
Erotic	1.14	1.00	-0.98	1.00	-0.10	1.00	-1.14	1.00	-2.12	1.00	-1.24	1.00
Disgust	-0.44	1.00	-1.35	1.00	0.78	1.00	0.44	1.00	-0.91	1.00	1.22	1.00
Fcz												
Neutral	-0.02	1.00	-0.13	1.00	1.53	0.52	0.02	1.00	-0.11	1.00	1.55	0.96
Violent	1.52	1.00	0.08	1.00	2.12	0.18	-1.52	1.00	-1.44	1.00	0.60	1.00
Erotic	1.46	1.00	-1.24	1.00	0.10	1.00	-1.46	1.00	-2.70	0.29	-1.37	1.00
Disgust	0.13	1.00	-0.90	1.00	1.03	1.00	-0.13	1.00	-1.03	1.00	0.91	1.00
Cz												
Neutral	1.16	1.00	1.99	0.07	0.00	1.00	-1.16	1.00	0.83	1.00	-1.17	1.00
Violent	2.75	0.17	1.97	0.22	0.20	1.00	-2.75	0.17	-0.78	1.00	-2.55	0.18
Erotic	0.95	1.00	0.03	1.00	0.30	1.00	-0.95	1.00	-0.92	1.00	-0.65	1.00
Disgust	0.54	1.00	0.45	1.00	-0.31	1.00	-0.54	1.00	-0.09	1.00	-0.85	1.00
Pz												
Neutral	1.70	0.99	1.46	0.69	-1.32	0.92	-1.70	0.99	-0.24	1.00	-3.02	0.06
Violent	2.89	0.09	2.28	0.07	-1.38	0.72	-2.89	0.09	-0.61	1.00	-4.27	0.00
Erotic	1.99	0.40	1.65	0.27	0.28	1.00	-1.99	0.40	-0.33	1.00	-1.71	0.56
Disgust	-0.13	1.00	0.76	1.00	-1.92	0.29	0.13	1.00	0.89	1.00	-1.79	0.81
300ms												

Fz												
Neutral	-0.33	1.00	-0.01	1.00	0.89	1.00	0.33	1.00	0.32	1.00	1.22	1.00
Violent	1.83	1.00	0.62	1.00	1.01	1.00	-1.83	1.00	-1.21	1.00	-0.82	1.00
Erotic	-1.91	1.00	-1.19	1.00	-1.55	1.00	1.91	1.00	0.72	1.00	0.36	1.00
Disgust	-0.63	1.00	-0.37	1.00	0.50	1.00	0.63	1.00	0.26	1.00	1.13	1.00
Fcz												
Neutral	0.30	1.00	0.00	1.00	0.84	1.00	-0.30	1.00	-0.31	1.00	0.53	1.00
Violent	1.82	1.00	0.07	1.00	1.01	1.00	-1.82	1.00	-1.75	1.00	-0.81	1.00
Erotic	-0.93	1.00	-1.54	1.00	-1.26	1.00	0.93	1.00	-0.61	1.00	-0.33	1.00
Disgust	0.20	1.00	-0.67	1.00	0.69	1.00	-0.20	1.00	-0.87	1.00	0.49	1.00
Cz												
Neutral	1.07	1.00	0.69	1.00	-0.03	1.00	-1.07	1.00	-0.39	1.00	-1.10	1.00
Violent	4.00	0.02	1.32	1.00	0.02	1.00	-4.00	0.02	-2.68	0.22	-3.97	0.01
Erotic	1.32	1.00	-0.07	1.00	0.24	1.00	-1.32	1.00	-1.39	1.00	-1.08	1.00
Disgust	2.10	0.36	0.27	1.00	-0.01	1.00	-2.10	0.36	-1.83	0.48	-2.11	0.26
Pz												
Neutral	1.99	0.40	0.21	1.00	-0.87	1.00	-1.99	0.40	-1.78	0.49	-2.86	0.03
Violent	4.60	0.00	1.02	1.00	-1.16	1.00	-4.60	0.00	-3.58	0.02	-5.75	0.00
Erotic	3.01	0.15	0.52	1.00	0.87	1.00	-3.01	0.15	-2.49	0.28	-2.14	0.52
Disgust	2.34	0.59	-0.52	1.00	-1.15	1.00	-2.34	0.59	-2.86	0.19	-3.49	0.06

ELPP												
Fz												
Neutral	-0.02	1.00	0.94	1.00	1.42	1.00	0.02	1.00	0.96	1.00	1.44	1.00
Violent	1.93	1.00	1.72	1.00	0.56	1.00	-1.93	1.00	-0.21	1.00	-1.38	1.00
Erotic	-2.47	1.00	0.57	1.00	-2.13	1.00	2.47	1.00	3.04	1.00	0.34	1.00
Disgust	-0.73	1.00	1.40	1.00	0.39	1.00	0.73	1.00	2.13	1.00	1.12	1.00
Fcz												
Neutral	0.52	1.00	0.85	1.00	1.18	1.00	-0.52	1.00	0.34	1.00	0.66	1.00
Violent	2.10	0.96	1.16	1.00	0.62	1.00	-2.10	0.96	-0.95	1.00	-1.48	1.00
Erotic	-0.82	1.00	0.82	1.00	-1.13	1.00	0.82	1.00	1.64	1.00	-0.31	1.00
Disgust	0.14	1.00	1.12	1.00	0.54	1.00	-0.14	1.00	0.98	1.00	0.40	1.00
Cz												
Neutral	0.57	1.00	0.69	1.00	0.31	1.00	-0.57	1.00	0.12	1.00	-0.26	1.00
Violent	3.74	0.01	0.85	1.00	-0.09	1.00	-3.74	0.01	-2.89	0.06	-3.83	0.01
Erotic	2.28	0.30	1.76	0.27	1.15	1.00	-2.28	0.30	-0.52	1.00	-1.13	1.00
Disgust	1.65	0.73	1.58	0.30	0.15	1.00	-1.65	0.73	-0.07	1.00	-1.50	0.80
Pz												
Neutral	0.92	1.00	-0.64	1.00	-0.83	1.00	-0.92	1.00	-1.55	0.62	-1.75	0.40
Violent	2.85	0.10	-1.10	1.00	-1.17	1.00	-2.85	0.10	-3.95	0.00	-4.02	0.00
Erotic	3.21	0.09	-0.62	1.00	1.83	0.39	-3.21	0.09	-3.83	0.01	-1.38	1.00

Disgust	1.38	1.00	-1.00	1.00	-1.27	1.00	-1.38	1.00	-2.38	0.29	-2.65	0.17
LLPP												
Fz												
Neutral	-0.35	1.00	0.91	1.00	1.16	1.00	0.35	1.00	1.26	1.00	1.51	1.00
Violent	1.45	1.00	1.38	1.00	-0.20	1.00	-1.45	1.00	-0.07	1.00	-1.65	1.00
Erotic	-3.65	0.58	-0.02	1.00	-1.81	1.00	3.65	0.58	3.63	0.47	1.84	1.00
Disgust	0.04	1.00	1.19	1.00	0.95	1.00	-0.04	1.00	1.15	1.00	0.92	1.00
Fcz												
Neutral	0.07	1.00	0.70	1.00	0.79	1.00	-0.07	1.00	0.63	1.00	0.72	1.00
Violent	1.25	1.00	0.88	1.00	0.06	1.00	-1.25	1.00	-0.37	1.00	-1.18	1.00
Erotic	-2.28	1.00	0.20	1.00	-1.16	1.00	2.28	1.00	2.48	0.90	1.12	1.00
Disgust	0.61	1.00	0.74	1.00	0.92	1.00	-0.61	1.00	0.13	1.00	0.31	1.00
Cz												
Neutral	0.42	1.00	0.31	1.00	0.43	1.00	-0.42	1.00	-0.11	1.00	0.01	1.00
Violent	2.11	0.26	0.46	1.00	-0.37	1.00	-2.11	0.26	-1.65	0.54	-2.48	0.07
Erotic	0.67	1.00	1.12	0.67	0.86	1.00	-0.67	1.00	0.45	1.00	0.19	1.00
Disgust	1.23	0.81	0.53	1.00	-0.11	1.00	-1.23	0.81	-0.71	1.00	-1.35	0.50
Pz												
Neutral	0.68	1.00	-0.61	1.00	-0.40	1.00	-0.68	1.00	-1.29	0.72	-1.08	1.00
Violent	1.82	0.57	-0.79	1.00	-1.12	1.00	-1.82	0.57	-2.61	0.07	-2.94	0.03

Erotic	2.28	0.15	-0.34	1.00	1.62	0.21	-2.28	0.15	-2.62	0.04	-0.66	1.00
Disgust	1.27	1.00	-0.50	1.00	-1.16	0.97	-1.27	1.00	-1.77	0.53	-2.43	0.12

*Highlighted values show significant results

Appendix W

Chapter 5.6 – Discussion

Visual representation of where the maximal ERP response amplitude was recorded for significant differences between within sex groups (i.e. HAM/LAM and HAF/LAF), across the six different method types in relation measurement sites and stimuli category, between high and low scoring males and females for the 100ms epoch.

Method Number (MN)	Method Name
1	Trait Aggression - Cut off point at '81'
2	Trait Aggression – Overall Median
3	Trait Aggression – Within-Sex Median
4	Trait Aggression – Overall 25th/ 75th Percentile
5	Trait Aggression – Within- Sex 25th/ 75th Percentile
6	Trait Aggression – K-Clusters

		Male								**Female**							
		High (HAM)				Low (LAM)				High (HAF)				Low (LAF)			
Site	Type	N	V	E	D	N	V	E	D	N	V	E	D	N	V	E	D
Fz	1																

	2																
	3																
	4																
	5																
	6																
Fcz	1																
	2																
	3																
	4																
	5																
	6																
Cz	1																
	2																

	3																
	4								×								
	5																
	6																
Pz	1																
	2																
	3																
	4																
	5																
	6																

Appendix X

Chapter 5.6 - Discussion

Visual representation of where the maximal ERP response amplitude was recorded for significant differences between within sex groups (i.e. HAM/LAM and HAF/LAF), across the six different method types in relation measurement sites and stimuli category, between high and low scoring males and females for the 200ms epoch.

Method Number (MN)	**Method Name**
1	Trait Aggression - Cut off point at '81'
2	Trait Aggression – Overall Median
3	Trait Aggression – Within-Sex Median
4	Trait Aggression – Overall 25^{th}/ 75^{th} Percentile
5	Trait Aggression – Within- Sex 25^{th}/ 75^{th} Percentile
6	Trait Aggression – K-Clusters

		Male								**Female**							
		High (HAM)				Low (LAM)				High (HAF)				Low (LAF)			
Site	Type	N	V	E	D	N	V	E	D	N	V	E	D	N	V	E	D
Fz	1						X										

	2																
	3																
	4																
	5																
	6																
Fcz	1						X										
	2																
	3																
	4						X										
	5						X										
	6																
Cz	1			X			X										
	2																

	3																
	4			✕													
	5																
	6																
Pz	1			✕													
	2																
	3																
	4																
	5																
	6																

Appendix Y

Chapter 5.6 - Discussion

Visual representation of where the maximal ERP response amplitude was recorded for significant differences between within sex groups (i.e. HAM/LAM and HAF/LAF), across the six different method types in relation measurement sites and stimuli category, between high and low scoring males and females for the 300ms epoch.

Method Number (MN)	Method Name
1	Trait Aggression - Cut off point at '81'
2	Trait Aggression – Overall Median
3	Trait Aggression – Within-Sex Median
4	Trait Aggression – Overall 25^{th}/ 75^{th} Percentile
5	Trait Aggression – Within- Sex 25^{th}/ 75^{th} Percentile
6	Trait Aggression – K-Clusters

		Male								**Female**							
		High (HAM)				Low (LAM)				High (HAF)				Low (LAF)			
Site	Type	N	V	E	D	N	V	E	D	N	V	E	D	N	V	E	D
Fz	1																

	2																
	3																
	4																
	5																
	6																
Fcz	1																
	2																
	3																
	4																
	5																
	6																
Cz	1																
	2																

	3																
	4							×									
	5																
	6																
Pz	1	×		×													
	2																
	3																
	4																
	5																
	6						×										

Appendix Z

Chapter 5.6 - Discussion

Visual representation of where the maximal ERP response amplitude was recorded for significant differences between within sex groups (i.e. HAM/LAM and HAF/LAF), across the six different method types in relation measurement sites and stimuli category, between high and low scoring males and females for the ELPP epoch.

Method Number (MN)	**Method Name**
1	Trait Aggression - Cut off point at '81'
2	Trait Aggression – Overall Median
3	Trait Aggression – Within-Sex Median
4	Trait Aggression – Overall 25^{th}/ 75^{th} Percentile
5	Trait Aggression – Within- Sex 25^{th}/ 75^{th} Percentile
6	Trait Aggression – K-Clusters

		Male								**Female**							
		High (HAM)				Low (LAM)				High (HAF)				Low (LAF)			
Site	Type	N	V	E	D	N	V	E	D	N	V	E	D	N	V	E	D
Fz	1																

	2																
	3																
	4																
	5																
	6																
Fcz	1																
	2																
	3																
	4																
	5																
	6																
Cz	1																
	2																

	3																
	4							×									
	5																
	6																
Pz	1																
	2		×	×													
	3		×	×													
	4	×		×													
	5			×													
	6		×	×													

Appendix AA

Chapter 5.6 - Discussion

Visual representation of where the maximal ERP response amplitude was recorded for significant differences between within sex groups (i.e. HAM/LAM and HAF/LAF), across the six different method types in relation measurement sites and stimuli category, between high and low scoring males and females for the LLPP epoch.

Method Number (MN)	**Method Name**
1	Trait Aggression - Cut off point at '81'
2	Trait Aggression – Overall Median
3	Trait Aggression – Within-Sex Median
4	Trait Aggression – Overall 25^{th}/ 75^{th} Percentile
5	Trait Aggression – Within- Sex 25^{th}/ 75^{th} Percentile
6	Trait Aggression – K-Clusters

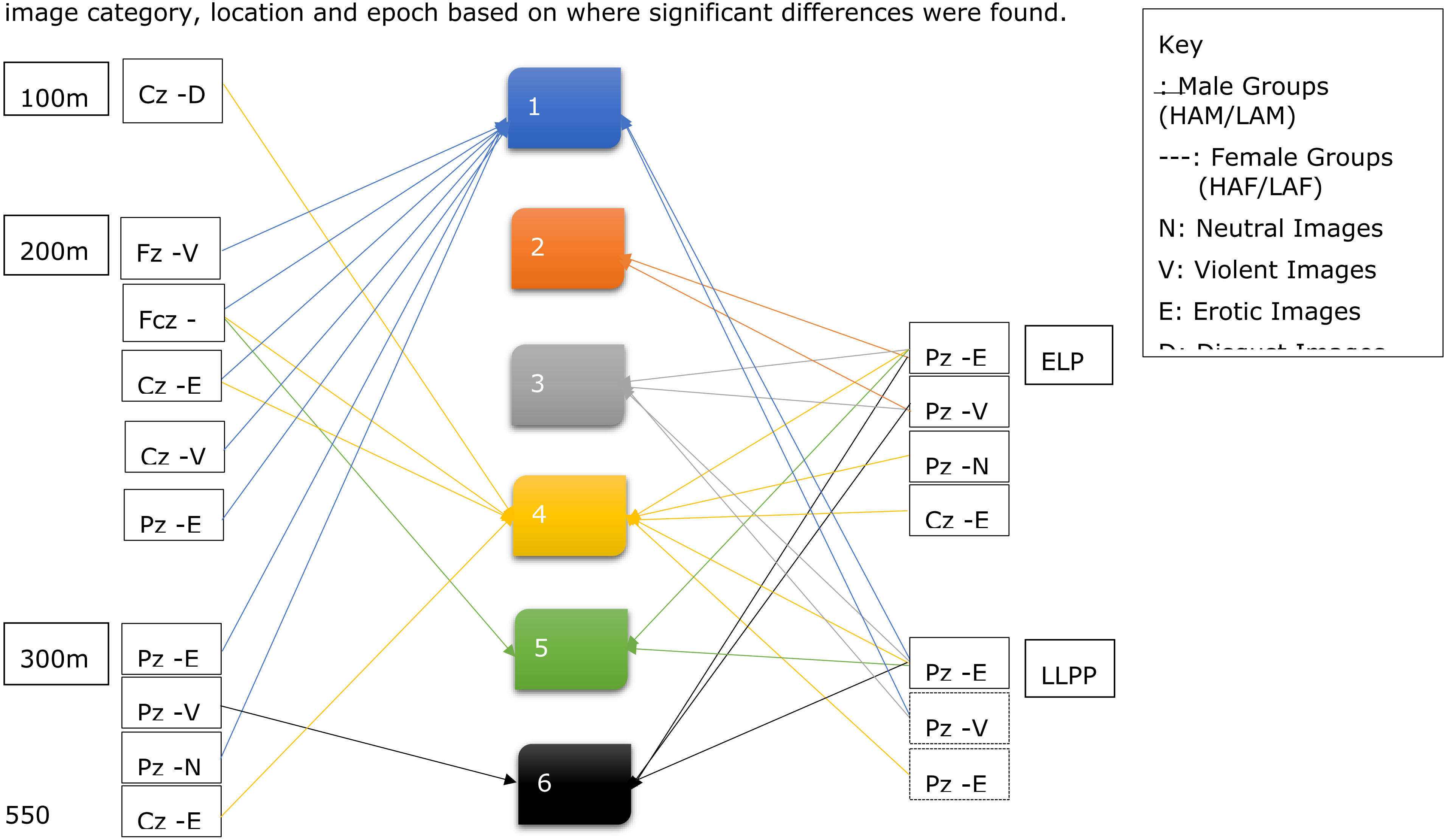
		Male								**Female**							
		High (HAM)				Low (LAM)				High (HAF)				Low (LAF)			
Site	Type	N	V	E	D	N	V	E	D	N	V	E	D	N	V	E	D
Fz	1																

	2																
	3																
	4																
	5																
	6																
Fcz	1																
	2																
	3																
	4																
	5																
	6																
Cz	1																
	2																

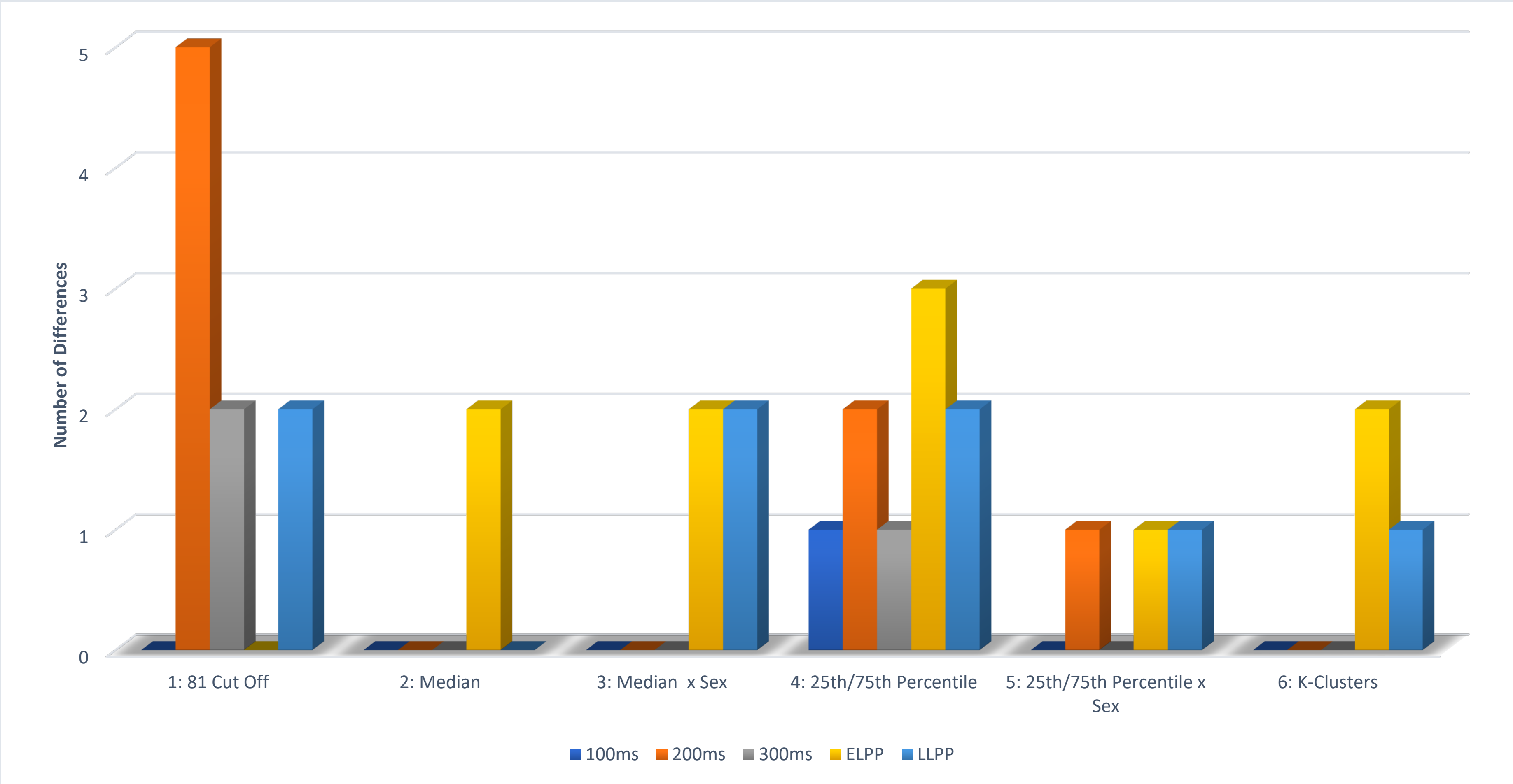
	3																
	4																
	5																
	6																
Pz	1			✕							✕						
	2																
	3			✕							✕						
	4			✕												✕	
	5			✕													
	6			✕													

Appendix AB

Visual representation of where the differences between methods (1-6) and groups (Group Membership), for each image category, location and epoch based on where significant differences were found.



Appendix AC



Visual representation of where groups (HAF/LAF and HAM/LAM) showed significant differences in ERP response amplitude between within-sex groups (i.e. HAM/LAM and HAF/LAF) across the six different method types and the five epochs. Thus, this identifies a tally of the amount of significant differences between the six data processing methods and clearly provided evidence of variance between method adoption.

Appendix AD

Chapter 6.5.1: Sex Differences Additional Data

Table of inferential statistics for Chapter 6.5.1 results. Independent samples t-test (two-tailed) results for mean ERP amplitude for males and females across the electrode site and epoch, in relation to image category.

	Epoch				
Region and Image Category	100	200	300	ELPP	LLPP
Fz					
Neutral	t=2.66, df=85, p=0.01	t=2.21, df=85, p=0.03	t=0.99, df=85, p=0.33	t=0.54, df=85, p=0.59	t=0.5, df=85, p=0.62
Clouds	t=0.96, df=85, p=0.34	t=1.71, df=85, p=0.09	t=-0.11, df=85, p=0.91	t=-0.3, df=85, p=0.76	t=-0.32, df=85, p=0.75
Water	t=2.58, df=85, p=0.01	t=2.9, df=85, p<0.01	t=0.75, df=85, p=0.46	t=0.02, df=85, p=0.98	t=-0.84, df=85, p=0.4
Deserts	t=0.19, df=85, p=0.85	t=1.73, df=85, p=0.09	t=-1.44, df=85, p=0.15	t=-2.12, df=85, p=0.05	t=-2.38, df=85, p=0.05
Landscapes	t=2.22, df=85, p=0.03	t=2.22, df=85, p=0.03	t=-0.7, df=85, p=0.49	t=-2.08, df=85, p=0.05	t=-1.37, df=85, p=0.18
Fcz					
Neutral	t=2.34, df=85, p=0.02	t=1.51, df=85, p=0.13	t=0.74, df=85, p=0.46	t=0.23, df=85, p=0.82	t=0.25, df=85, p=0.8

Clouds	t=1.15, df=85, p=0.25	t=1.47, df=85, p=0.14	t=0.05, df=85, p=0.96	t=-0.23, df=85, p=0.82	t=0.17, df=85, p=0.86
Water	t=3.36, df=85, p<0.01	t=2.22, df=85, p=0.03	t=0.59, df=85, p=0.56	t=-0.06, df=85, p=0.95	t=-0.67, df=85, p=0.51
Deserts	t=0.28, df=85, p=0.78	t=1.37, df=85, p=0.17	t=-1.42, df=85, p=0.16	t=-2.11, df=85, p=0.05	t=-2.31, df=85, p=0.05
Landscapes	t=2.49, df=85, p=0.01	t=2.01, df=85, p=0.05	t=-0.31, df=85, p=0.76	t=-1.66, df=85, p=0.1	t=-0.42, df=85, p=0.68
Cz					
Neutral	t=-4.08, df=85, p<0.01	t=-3.51, df=85, p<0.01	t=-1.76, df=85, p=0.08	t=-1.22, df=85, p=0.23	t=-0.4, df=85, p=0.69
Clouds	t=-3.06, df=85, p<0.01	t=-3.7, df=85, p<0.01	t=-3.81, df=85, p<0.01	t=-3.61, df=85, p<0.01	t=-2.63, df=85, p=0.01
Water	t=-1.86, df=85, p=0.07	t=-1.89, df=85, p=0.06	t=-2.12, df=85, p=0.04	t=-2.08, df=85, p=0.04	t=-0.84, df=85, p=0.41
Deserts	t=-0.55, df=85, p=0.58	t=-2.35, df=85, p=0.02	t=-3.01, df=85, p<0.01	t=-3.41, df=85, p<0.01	t=-1.67, df=85, p=0.1
Landscapes	t=-1.89, df=85, p=0.06	t=-3, df=85, p<0.01	t=-3.4, df=85, p<0.01	t=-2.49, df=85, p=0.01	t=-0.29, df=85, p=0.77
Pz					
Neutral	t=-3.4, df=85, p<0.01	t=-3.9, df=85, p<0.01	t=-2.53, df=85, p=0.01	t=-1, df=85, p=0.32	t=-0.52, df=85, p=0.61

Clouds	t=-4.57, df=85, p<0.01	t=-3.93, df=85, p<0.01	t=-3.96, df=85, p<0.01	t=-4.2, df=85, p<0.01	t=-3.46, df=85, p<0.01
Water	t=-3.47, df=85, p<0.01	t=-2.8, df=85, p=0.01	t=-1.31, df=85, p=0.19	t=-2.7, df=85, p=0.01	t=-1.35, df=85, p=0.18
Deserts	t=-1.75, df=85, p=0.08	t=-2.47, df=85, p=0.02	t=-1.1, df=85, p=0.27	t=-1.88, df=85, p=0.06	t=-1.18, df=85, p=0.24
Landscapes	t=-3.79, df=85, p<0.01	t=-3.76, df=85, p<0.01	t=-2.14, df=85, p=0.04	t=-0.94, df=85, p=0.35	t=-1.45, df=85, p=0.15

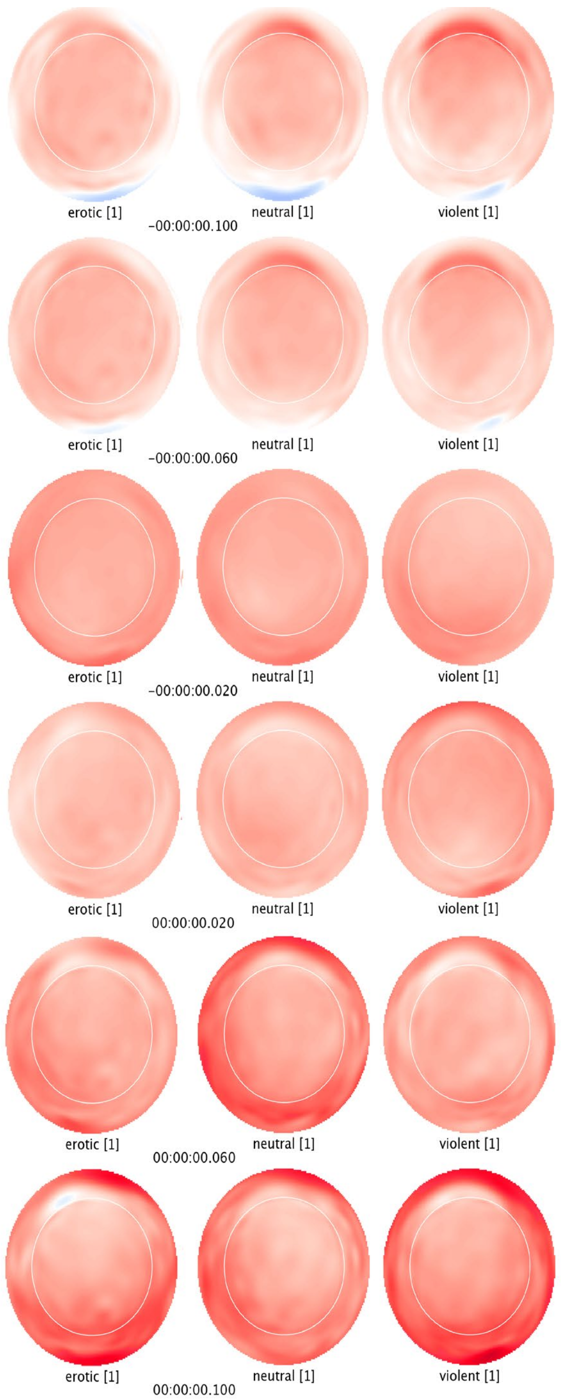
*Highlighted values show significant results

Appendix AE

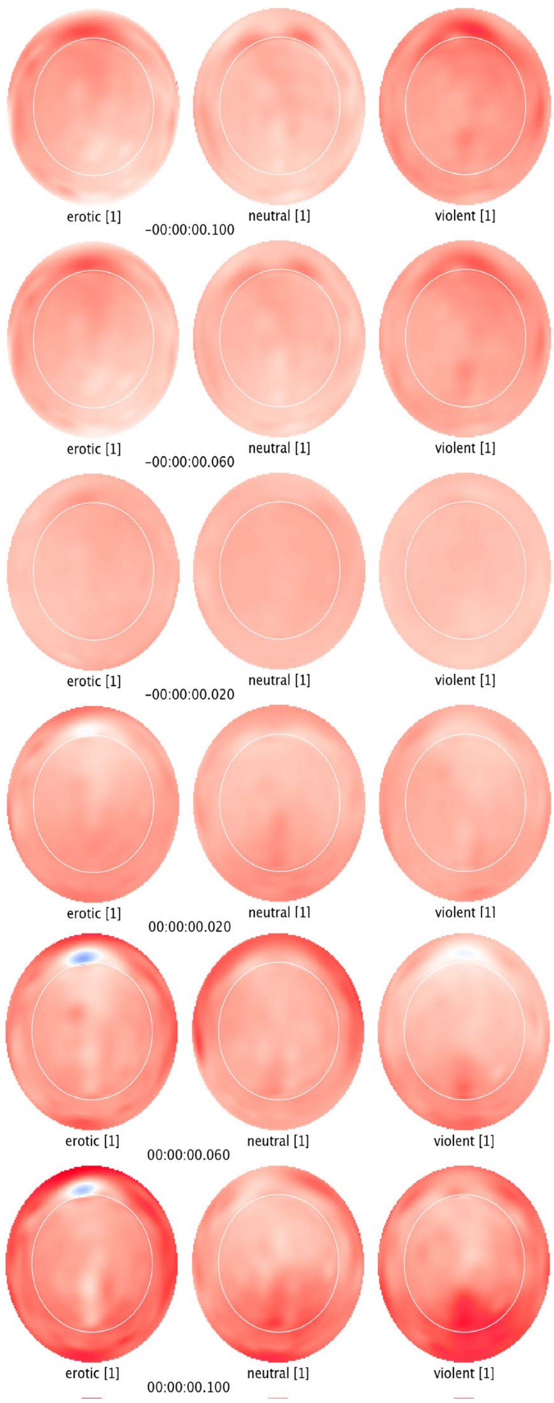
Chapter 3: Topoplot Images

Visual representation of the grand averaged ERP activation across the male and female cortices in response to the differing image categories across time (milliseconds).

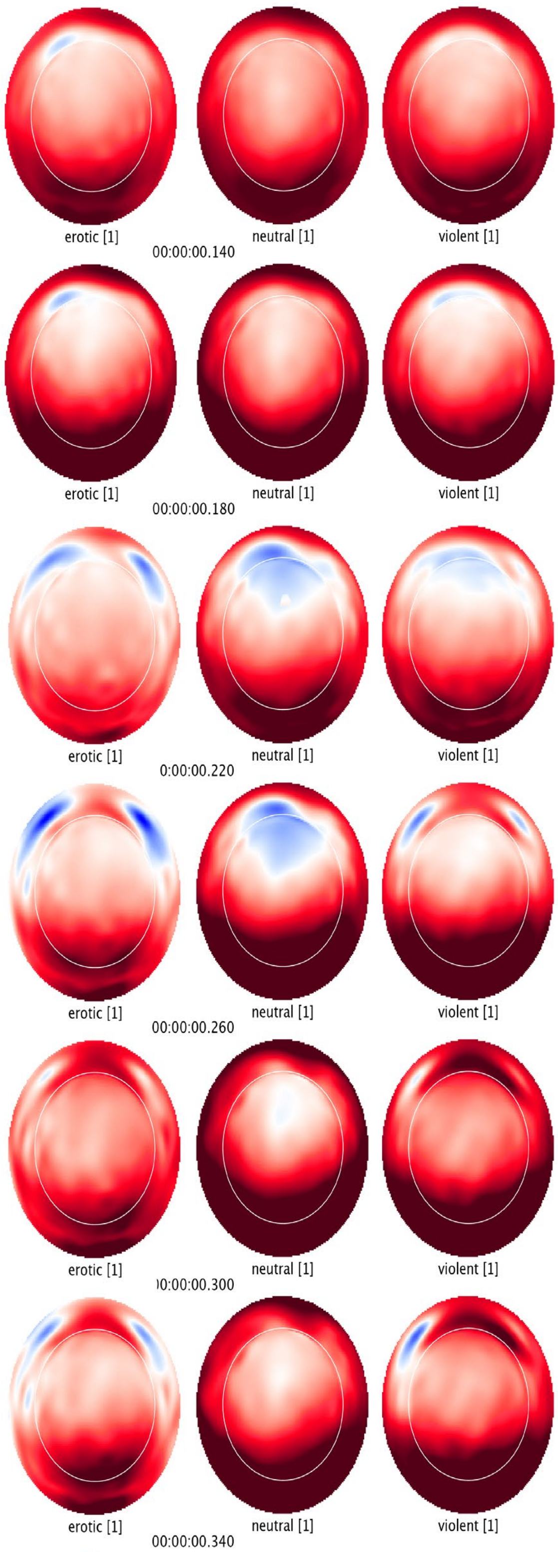
Males



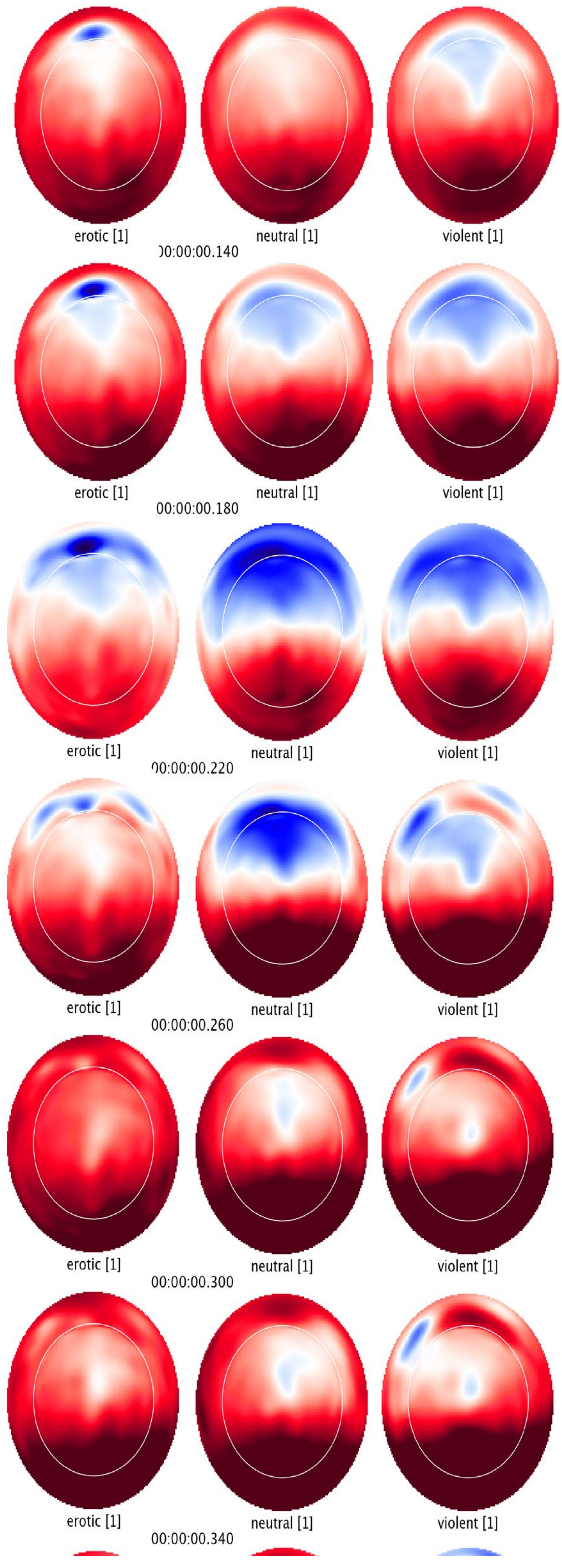
Females



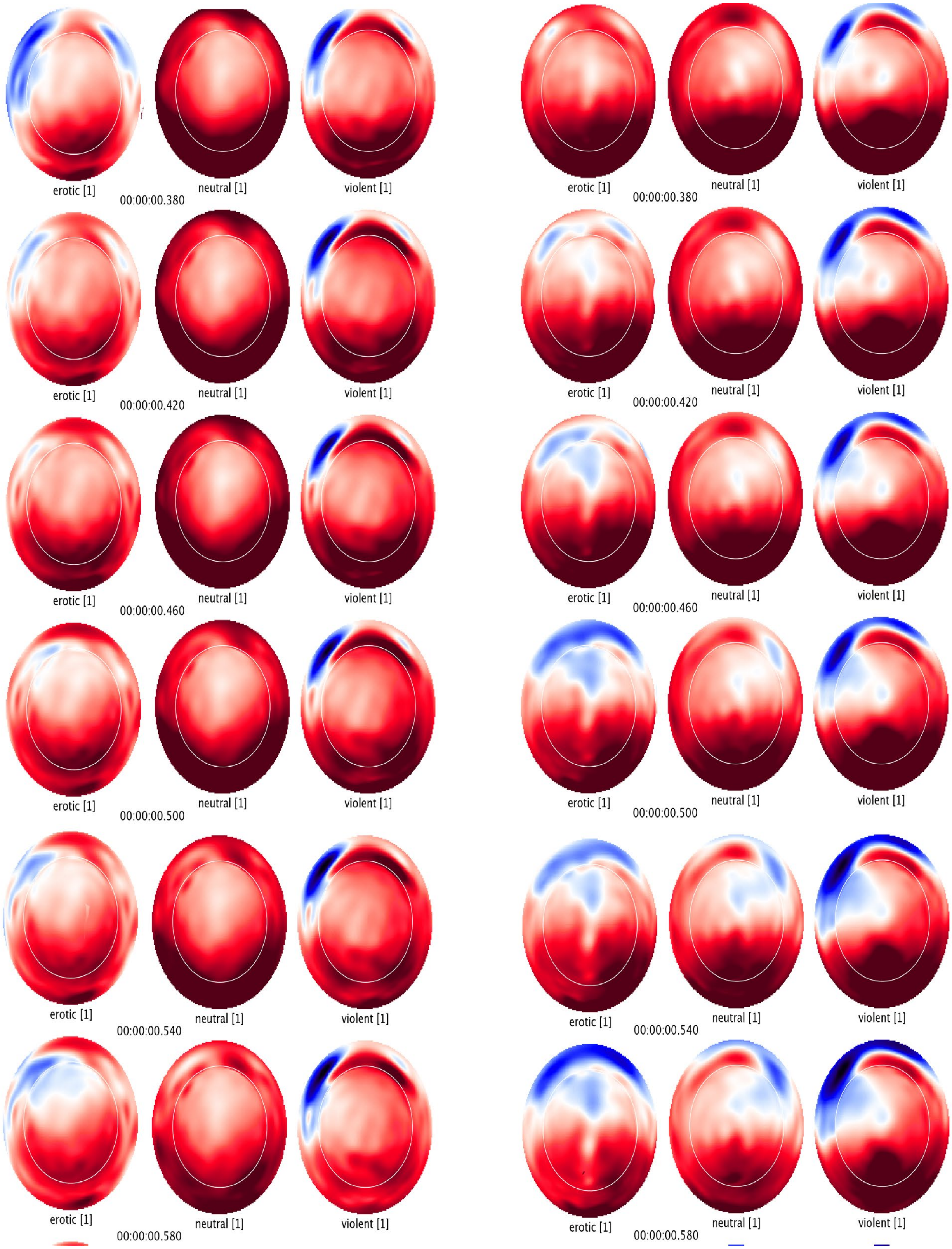
Males



Females

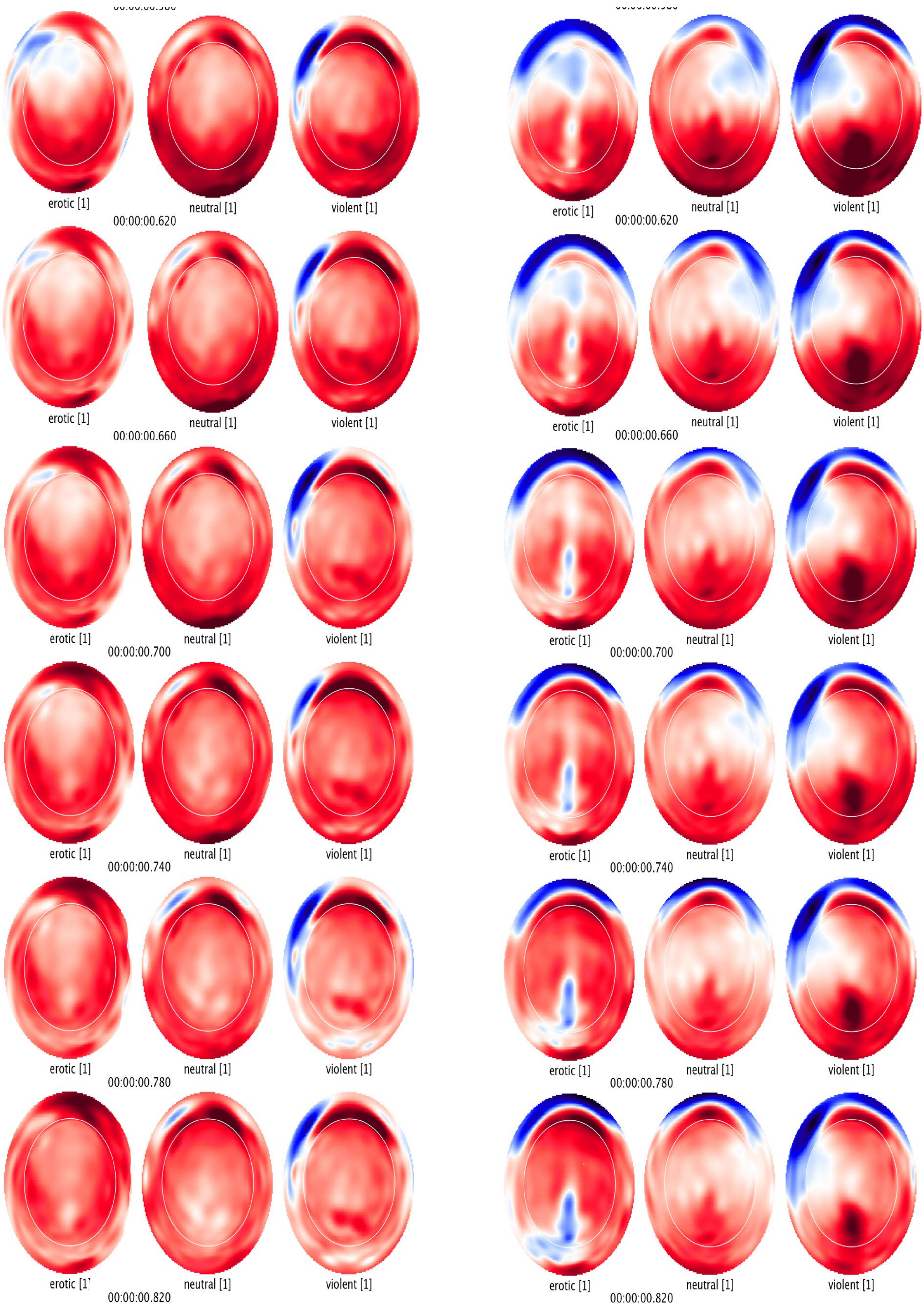


Males Females



Males

Females



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