The Effect of Physical Weight and Stimulus Spatial Location on Lexical Decision: Implications for Embodied Cognition

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Abstract

Traditional models of cognition within cognitive psychology have utilised dualistic perspectives and largely ignored the roles of the motor systems and bodily experiences. More recent embodied approaches have sought to combat this dualism by incorporating the motor systems and bodily experiences into their perspectives. Recent research has highlighted the role of bodily experiences in shaping cognition (Proffitt, 2006; Jostmann et al., 2009), how language comprehension can be embodied and grounded in physical experiences (Glenberg and Kaschak, 2002; Zwaan and Yaxley, 2003) and also how stimulus spatial location can influence responses (Meteyard et al., 2008; Dunn et al., 2014). The present study aimed to explore those areas and provide empirical evidence in support as well as explore a gap in current research. The literature search indicated an abundance of embodied system research but a lack of research looking at possible interactions between the systems, it was this gap that was explored within the present study. Utilising a lexical decision task and methods similar to that of Proffitt (2006) three experiments were conducted. A total of 64 participants underwent standard and spatial lexical decision tasks. Three experiments were conducted exploring the bodily effect of weight, stimulus spatial effect and interactions between embodied systems.Results from the three experiments displayed a lack of support for past research regarding the effect of the bodily experience of weight. Results also displayed a main effect of word type leading to the indication that the comprehension of the word/non-word letter strings affected task performance. Analysis of results proposed that a cohesion effect between embodied systems facilitated task performance. It was concluded that further research is needed in order to fully understand the possibility of dominance or cohesion effects within an embodied perspective.

The Effect of Physical Weight and Stimulus Spatial Location on Lexical Decision: Implications for Embodied Cognition

The emergence of cognitive psychology in the 1960's as a revolt against the dominant views of the behaviourists, saw an introduction of a new way of looking at psychology. This new perspective brought in a strictly scientific method and introduced the idea that there is more to psychology than just observing behaviour, the study of the inner world of the individual was the focus of this perspective. This cognition would remain at the forefront of study for many years to come. However as years progress and knowledge expands so too must theoretical perspectives. This paper aims to explore the traditional cognitive perspectives and critically assesses the efficacy of such approaches. Alternative perspectives will be explored, as well as past and present literature on each of the perspectives proposed.

In this introduction the roots of cognitive psychology will be explored and critically assessed. The foundations and implications of the traditional cognitive approaches will be outlined and discussed. Literature from a variety of sources and models will be discussed in terms of their efficacy as explanations of cognition. After which, challenges drawn from more recent embodiment theorists and literature will be discussed. Embodied cognition perspectives and models will be put forward as challenges to highlighted shortcomings of traditional models. Literature and theoretical models will be used to describe the development of the embodied perspectives.

Experiment one will then be introduced and an explanation of the rationale provided. Conclusions drawn from experiment one will be discussed and an outline for progression will be made. Theoretical explanations of the findings of experiment one will introduce the topic of experiment 2A. Experiment 2A will then be introduced with rationale and discussions also provided. Experiment 2B will follow with rationale and discussion of findings, a general discussion will follow and provide critical analysis of theories, research and methodological issues.

The Roots of Cognitive Psychology

The theoretical underpinnings of the traditional cognitive models can be traced back to the work by Shannon (1948) on his Information Theory. This theory proposed that information was communicated by means of signals being sent using a sequence of stages or transformations. From this it was proposed that human perception and memory could be thought of in a similar manner. It was argued that sensory information could be fed into perceptual analysers, these would then output into memory systems. The proposition of Shannon's (1948) information theory was seen as the birth of the information processing approach that cognitive approaches would utilise.

Broadbent's (1958) Perception and Communication theory can be argued to be one of the first major theories within an information processing type of psychology. This theoretical perspective put forward by Broadbent (1958) claimed that information output from perceptual

systems encountered a filter, this filter then only passed on information that the individual was attending to. This model provided, at the time, a novel insight into an individual's psychology. This model was novel at the time due its mechanistic account and focus on selective attention. This contrasted with the previously massively influential Behaviourist models that had dismissed information processing accounts of selective attention.

Broadbent (1958) argued that any information that passed the filter moved into a 'limited capacity decision channel,' this was a system that bore some of the properties that the short term memory. The information then went on to the long term memory system. The latter parts of this model proposed by Broadbent (1958) that detailed a transfer of information between the two memory systems would become one of the central points of dual memory models developed further in cognitive psychology.

The quantitative measure and use of 'bits' to measure information within the Information Theory was another feature that drew the interest of psychologists. Although Miller (1956) showed that short term memory limits had very little to do with the use of bits, his later work into the technical aspects of information theory fuelled mathematical psychology an area of psychology that was developed by Estes and Burke (1953), Luce (1959) and Garner (1962).

A second external influence on the development of the traditional cognitive psychology can be seen to date back to the technical developments during World War II. The development of digital computers led to the comparison of those systems and human intelligence (Turing, 1950). The development of a computer program that could solve complex logical problems challenged the notion that such a thing was unique to humans (Newell et al., 1958). Miller et al. (1960) argued that information processing psychology could use the theoretical language of computer modelling to provide a rich representation of psychological information.

More programs soon followed on from that of Newel et al. (1958) displaying that computers were able to problem solve with the same ability as that of their human counter parts, thus leading to the development of the Computer Metaphor of cognition that centred around cognition in humans being very similar to the actions of machines constructed by the likes of Turing (1950) and others.

Another influence on the rise of cognitive psychology was the development of generative grammar in linguistics by Chomsky (1957). The focus on the mental structures needed to represent the kind of linguistic knowledge that any individual that can speak a language competently must have, had a profound effect on the development of cognitive psychology. This generative linguistics approach claimed that associations and phrase structure grammars could not fully represent an individuals knowledge of syntax and that a component that was capable of transforming one syntactic structure to another was needed.

It was this method of thinking by Chomsky (1957) that would usher in a change of perspective in domains such as linguistics and psycholinguistics. Chomsky's (1959) review of Skinner's (1957) Verbal Behaviour has been argued to be one of the most "significant documents

in the history of cognitive psychology" (Smith, 2001) and was cited to undermine behaviourism as a serious approach to psychology.

Bruner et al. (1956) has been cited as another source for the development of cognitive psychology. The book looked at how individuals learn new concepts and categories whilst emphasising strategies of learning rather that focussing solely on associative relations. When looking at the proposals put forward by Bruner et al. (1956) it was clear to see just how well they fit with an information processing approach further adding to the mounting reasons to break away from a behaviourist approach.

The Computer Metaphor of Cognition

The growth of cognitive psychology was facilitated by the invention of the computer. Theorists and researchers alike saw an uncanny resemblance between the individual and computer. It was argued that both had the ability to store, transform and process symbolic information (Neisser, 1976). Viewing cognition in this manner led to the rise of the computer metaphor being adopted in abundance by many cognitive researchers and theorists. In a basic explanation of the computer metaphor there are clear similarities between the mind and a computer. This was seen in the possibility of the mind being governed by programs or sets of rules analogous to those which govern computers (Casey and Moran, 1989).

Basic characteristics of computational psychology have been expressed by Boden (1988). It was claimed that mental processes can be defined functionally and in terms of their causal role and also that such processes are generated by a specified set of instructions within the mind. Another characteristic is that the mind is regarded as a representational system thus leading psychology to be considered as the study of various computational processes whereby mental representations are constructed, organised, interpreted and transformed (Boden, 1988).

Viewing cognition in terms of a computer metaphor also lead to the adoption of a dualistic approach (Atkinson and Shiffrin, 1968; Kahneman and Tversky, 1979). The dualistic approach would view the mind and body as being two separate entities. This dualistic approach to cognition would also specify that knowledge was located within a system of semantic memory that is separate from the modal systems used for perception and action. Two fundamental claims were put forward by the computer metaphor.

The first of these claims was that the internal mind was separate from the external body (Block, 1995), much like the separation of software and hardware inside a computer. The second claim being that high level cognition was performed by utilising an amodal architecture and amodal symbols that formed relationships with the perceptual states that form them (Pylyshyn, 1984). Fodor (1983) also noted a similarity between the mind and the computer central processor in the way that the motor and sensory systems interact with amodal representations.

The value of this computational approach was emphasised by Allport (1980), Boden (1979,1988) and Sloboda (1986). There were two main classes of advantages this approach was claimed to possess. The first of these advantages was the theoretical advantage this approach provided. Boden (1988) claimed this approach was theoretically advantageous due to the conceptual focus being on representations and processes of symbolic transformations. Boden (1979) also proposed that the concept of programs regulating behaviour could enable the understanding of the possibility for an immaterial mind and a material body to be closely related.

The second advantage was evident in relation to methodology. Boden (1979,1988) and Mandler (1984) claimed that methodologically the computational approach to cognition could easily serve as a useful tool for testing psychological theories. Sloboda (1986) also claimed that the intellectual discipline it took to create a program that actually works was a valuable tool for better theorising. Giving the computational approach a reciprocal feel as program development aided theory thus advancing programs and so-forth.

The offer of a manageable way to represent complexity and the ability to infer implications of a program that an unassisted mind would be unable to do that computer modelling offered, would also show the computational approach as an attractive option to psychologists. Claxton (1988) also acknowledged that 'computational criterion' brought in to the spotlight by the computational approach added a lot of value to the approach due to the efficacy it provided in evaluating psychological theories.

A damaging criticism of the digital computer metaphor came in the form of the distinction of separation between the mind and body. The computational analogy largely ignored the role of the body which could be problematic as the body is an integral part of the individuals interaction with the environment around them. Ornstein (1986) warned that if the role of the body was ignored by computational psychologists they risked developing 'academiomimesis', a disorder where a delusion occurs that sees the mind as consisting of only verbal and logical processes. Norman (1980) argued that if the body was ignored and individuals were seen merely as physical symbol systems then theorists and researchers ran the risk of concluding that people were pure intellects.

If people are in actuality pure intellects then the body need not be considered in a theory of cognition. However accepting this assumption leads to another assumption of every individual being the same. Papert (1988) criticised this way of thinking and claimed that there is more to learn from studying differences between individuals that similarities. In reality and in practice the theorists and researchers that accept a traditional computational approach to cognition neglect and ignore important topics such as individual differences, emotions and motivations in relation to the facilitation of both the development of cognition and cognition as a whole (Norman, 1980).

To accept a dualistic view of cognition is to focus on the neurologically possible, which is reliant on the perceptual system. Traditional theories have been seen to ignore the motor system and the feedback it could have provided. To ignore such a system can be seen as dangerous and damaging to the credibility of an approach. Research has demonstrated the efficacy of factoring in the interaction and feedback from the motor system. Englecamp (1995) found that enacting a task

produces better memory recall for the event rather than just observing it. Craik et al. (1999) and Cloutier and Macrae (2008) also found that memory is also enhanced when the individual relates items to themselves. There is evidence therefore that the motor system should not be ignored when attempting to encapsulate a full view of cognition. Evidence appears to support the self knowledge and self involvement that individuals possess with regard to facilitation of cognition.

The inherent trait that runs through the vast majority of traditional theories of cognition is that of the dualism between mind and body first conceptualised by Descartes (Rozemond, 2009). A cartesian approach to viewing the mind and body would see them as being opposite in nature (Tomy, 2011). The mind is seen as a thinking object that is unextended and indivisible whereas the body is an extended and divisible object. These claims are apparent when viewing works from theorists and researchers that contributed to cognitive psychology (Atkinson and Shiffrin, 1968; Kahneman and Tversky, 1979; Block, 1995). The notion of the separation between mind and body is one of keen interest. Cognitive psychology has traditionally largely ignored the role of the body and focused more on studying the mind and the symbols and architectures that construct it. Questions must be raised however as to the efficacy of adopting such an approach. To ignore the body is to ignore an individuals interaction with their environment, to ignore such interactions could prove problematic.

Amodal Systems and Architecture

When looking at the traditional cognitive model of psychology and the architecture it proposed for cognition it is important to note the work of Turing (1950) his analysis of computation and his Turing Machine. Maintaining the functional distinction between control and memory but blurring the structural distinction by hardwiring the control to a finite memory therefore containing the system in to a single box (Wells, 1998) provided an apt way of constructing a cognitive architecture. This blurring effect ultimately lead to three main ideas.

The first of these ideas was the transformation of an interaction between an active control mechanism and a qualitatively different external medium in the Turing machine in to an interaction between different parts of an internal system. The second idea was that the existence of working computers provided plausibility to mental functioning resulting from a similar functional distinction in the architecture of the brain. The third idea was the underpinning of mental computation is internal symbol processing.

It was these three ideas that would lead to the hypothesis that the behavioural and cognitive flexibility of the human mind results from the structural architecture of the brain implements the task architecture of a universal machine.

The notion of the architecture of the mind being functionally equivalent to a Turing machine that is embedded in the peripheral systems, communicating with the external world was accepted and advocated by Newell (1980,1990), Fodor (1983) and Pylyshyn (1984). Internal symbol

processing and the requirement of structures and processes transforming physical stimuli into symbolic structures were central tenants of the works proposed by Newell, Fodor and Pylyshyn.

Newell and Simon (1972) claimed that programmability, that implies universality, was key to understanding the flexibility of human behaviour. The commitment to universality was to become explicit within the works of Newell (1980;1990). This differed from the works of Fodor (1983) and Pylyshyn (1984) whose works allowed for but did not require programs to be encoded explicitly as symbol structures. Conversely they claimed that data, the symbols that are utilised, must be encoded, yet these only correspond to the machines data structures rather than its rules of state.

Clarity from Fodor and Pylyshyn on as to if they consider all programs to be implicit or explicit would help to identify if the cognitive architecture could be universal. This need for clarity can be seen as important as if programs are all implicit it would therefore mean the cognitive architecture could not be universal as only a finite number of programs could be wired in to a finite system such as a brain. Leading to an assumption that the brain would only be able to hold a finite amount of thoughts. If at least some programs were explicit then there would have to be an interpretation mechanism somewhere in the architecture, which would allow the architecture to be universal.

As amodal symbols were transduced from perceptual states they entered a representational structure such as a schema or semantic network which in turn constituted a fully functional symbolic system. Newell and Simon (1976) sought to create a formal hypothesis that centred around the use of amodal symbols in relation to cognition. The Physical Symbol System Hypothesis (PSSH) stated that a physical symbol system had the necessary means for action that could be deemed as intelligent. This implied that if provided with appropriate symbol processing programs, computers could be capable of intelligent action. A second implication of this hypothesis was that symbolic behaviour of man arose because man had characteristics of a physical symbol system.

The PSSH consisted of three main features. The first of these was that symbols have a physical instantiation and that these physical symbols could stand in for real things such as colours and images. The second feature of the PSSH was that symbols were manipulated by rules much like the if-then operations of programs on a computer asserting that human thought was the manipulation of symbols using rules. The third feature of the PSSH was that both human and computer symbols were seen as being related to the referent. Meaning that just as a sequence of ones and zeroes representing a concept in a computer doesn’t actually sound or act like the concept or object neither does the human mental representation of a concept or object resemble the actual concept or object.

This view enabled a great amount of efficiency as it ensured nothing extraneous would be able to interfere with the symbol it also ensured the possibility of limitless symbols even if human ability was limited it also ensured that computer symbols and human symbols were the same in kind (Glenberg et al., 2013). Glenberg et al. (2013) cited language as a good analogy for the PSSH

they noted that within languages there are words that act like symbols and syntax that act like rules for combining the symbols.

The PSSH was arguably the driving force behind the conception and execution of the computational approach (Newel and Simon, 1972). The PSSH proposed that symbols are the primitive components of the mind and that humans and computers are part of a larger class of processing systems. Pair this with the assumption that this is a definitive similarity between the mind and computer and this analogy is the basis of the computational approach. The question must be raised as to just how effective and valid this analogy is.

Evidence was found that suggested that the digital computer is not an accurate model of the human brain. Pinker and Prince (1988) argued that there is a fundamental difference in the way that the human brain and a digital computer work. They noted that computers process information serially whereas the human brain works to process information in a parallel manner. Kline (1988) also noted differences between the brain and a digital computer. Kline (1988) noted that the brain operates slower than a computer and that the brain was far more adaptable, more tolerant of error and context sensitive.

Although these claims aren't definitive proof that the computational approach is completely erroneous they do provide some interesting points that question the validity of the analogy of the brain and the digital computer. It is important however to consider the date of the claims Kline (1988) made. At such a time computing and processors were in their infancy, a look at any modern computer will see a clear parallel processing approach as computers contain multi-core processors that allow for parallel processing.

Early models that adopted the PSSH also showed that the PSSH to be problematic. The CHARM model (Metcalfe, 1982;1985;1990) used complex operations of convolution and correlation for memory encoding and retrieval (Glenberg et al., 2013), these operations preserved similarity between symbols throughout transformations. This model was also beginning to strive for representations that could be instantiated by neurons that were a more realistic relation to the structure of semantic memory (Glenberg et al., 2013).

The notion of trans-situational identity of symbols was another area that caused issue for the PSSH. This was due to this element of trans-situational identity of symbols working well with computers but not working very well with humans. Experimental data demonstrated that the symbols used by humans were not immutable, concepts that an individual imagined in a certain context was different to the same concept imagined in a different context judging that memory was context specific and dependent on the specificity of encoding (Tulving and Thomson, 1973).

The role of the self in cognitive processing was also highlighted as another issue with the PSSH. Although the PSSH did account for data on memory and cognition it failed to make an attempt or acknowledge the role of the self. Tulving (1993) claimed that episodic memory included a self knowing consciousness, a claim that saw more evidence support it (Wheeler et al., 1997).

The extensive studying of autobiographical memory saw the attempt to conceptualise and implement something like a self and also characterising its function seemed to be beyond the scope of models of memory and cognition. This could have been due to the fact that although the operations used in the models were neurologically possible they only utilised the perceptual system, completely ignoring the motor systems or any possible feedback they could have provided.

As mentioned earlier it is worth noting that memory has been found to be massively enhanced when the self is involved (Engelcamp, 1995; Cloutier and Macrae, 2008; Craik et al., 1999; Macrae et al., 2004). The involvement of context dependent memory where the context was provided by a bodily action and bodily feedback highlighted the flaw in the PSSH for the lack of involvement regarding motor systems. The evidence of self knowledge and self involvement clearly shows that from within a PSSH account of cognition something is missing.

The Language of Thought

Another theoretical perspective that cited a language like structure in the facilitation of thought and cognition was Fodor's (1975) Language of Thought (LoT) hypothesis. The LoT proposed that thought and thinking were carried out within a physically innate mental language, a language that Fodor (1975) named 'Mentalese'. The mental language that the LoT proposed consisted of a compositional symbolic or a representational system that contained semantic content (Fodor, 1987;1990). These were then governed by syntactic specification that provided cognition with a language like structure.

There were three main claims that could be derived from the LoT when seeking to provide an explanation for the process of cognition. The first of these claims was that cognitive processes exist in causal sequences of tokenings of internal representations within the brain. In order for representations to become tokened they must be causally sensitive to different conditions and environments, tokenings were also argued to be sensitive to one another which was the second main claim of the LoT.

This first claim also argued for the existence of Mentalese due to the causal structuring and use of defined syntax tying in with the third claim of the LoT which was that the internal representations have combinatorial syntax and semantics (Fodor, 1975; Fodor and Pylyshyn, 1988). When looking at thought the LoT was mainly concerned the nature of propositional attitudes. It was claimed that propositional attitudes could be realised due to a relation the organism or individual has with its own internal representations. To be able to hold a propositional attitude first you must have representations capable of facilitating intentions.

When formulating the LoT Fodor (1975) took note of advances in cognitive science and claimed that the empirical findings within the field drew explanations in terms of a mental language. The advances within the field claimed that cognitive processes were inherently computational, which would later be referenced as the Computational Theory of Mind (Putnam, 1980). The

assumption that cognitive processes are computational also draws the assumption that a jump to a representational system is not out of the question.

When taking the considerations of Fodor (1975) in to account it could be argued that there is some merit in viewing the working of the mind as similar to that of a language. This inference leads to proposition of there being an infinite amount of representations that remain systematic and productive in the composition of representations. Although mentalese was not recognised as a natural language the differences between mentalese and natural languages were noted in terms of a machine analogy, it could be argued that mentalese was the basis of cognitive processing and is hard-wired but the input and output would be handled by the natural language.

Although the LoT does appear to have a plausible basis for the perspective of cognition it puts forward, it is not without question. One major problem with proposing a hypothesis such as the LoT is the difficulty of empirically investigating the claims that are made. As individuals do not have any access the mechanisms or symbols the LoT argues are the formations of our beliefs and due to the fact that the symbols and mechanisms aren't measurable or observable providing true empirical data for their existence remains challenging to say the least.

As mentalese was a corner stone of the LoT it is important to examine Fodor's (1975) claim that mentalese could be determined as a language. It can be argued that to be considered a language mentalese must resemble natural languages in several aspects. Firstly it would be important to apply means of linguistic study upon mentalese to fully investigate the claim that mentalese is actually a language.

Sassure (1977) argued that the most basic and plausible notion in all linguistic research was the distinction between signifier and signified. This distinction is seen as a general claim of both written and spoken languages and linguistic signs. To look at two different strands of linguistics it would soon be evident that there would be no sure reason for a string to be attached to a certain concept, thus signifying the relationship between the concept (signified) and the corresponding sign (signifier) is arbitrary. For a language, such as mentalese, to be classified as a natural language it must at the very minimum meet these requirements otherwise the relation between the sign and the concept would collapse.

Although the use of the amodal architectures, symbols and hypotheses mentioned have an abundance of support, they are not without question. Even Fodor (1998) himself noted that there was an issue with the frameworks rejecting radical concept nativism and therefore changed his viewpoint on the mind and cognition.

What can be argued as a major flaw of utilising an amodal approach to cognition is the process of re-description of amodal symbols to states that are modally specific from the start. The lack of empirical evidence for such a process is worrying, there are theoretical accounts from different researchers as to what is happening during this process (Fodor, 1975; Pinker, 1999; Niedenthal et al., 2005) however the lack of empirical evidence can be seen to doubt the credibility of accepting such accounts.

A lack of empirical evidence is can also be seen when looking at the claim of the brain containing or utilising amodal symbols. If accounts such as these are to be accepted as scientifically valuable or correct it is important for them to provide empirical evidence to substantiate their claims. Accepting a theory on the blind faith of the theorist or researcher could lead down a path of false knowledge based on theories that would be unfalsifiable. This could then render the theorising of amodal as incorrect and introduce the need of a new perspective to provide an explanation of cognition.

Considering the critiques posed so far against the traditional models of cognition there appears to be a running theme. It was noted multiple times that the lack of inclusion of motor systems when considering the facilitation of cognition is problematic. The dualism adopted by the traditional model ignores the body, thus ignoring the motor systems and the individuals interactions with their environments. It must be questioned as to whether this approach is one that is fully acceptable.

The question must be asked as to if it is wise to ignore such things as the body and the interaction between the body and environment, especially when such ignorances have been pointed out as flaws of traditional accounts. It would appear therefore that a new approach may be needed, one that accounts for the inclusion of motor systems, the body and the interaction of the body within the environment.

An Introduction to Embodied Cognition

Over the past few decades of research and theorising within cognitive science there has been a reaction to issues and problems noted with the traditional approach. Within cognitive psychology theorists have been adopting and developing a new approach to understanding cognition. This new approach challenges the traditional views on cognition, such as the mind body dualism, amodality and language based approach.

Instead this new approach placed more focus on knowledge being embodied in bodily and modality specific states within the brain (Clark, 1999; Barsalou, 1999,2008; Glenberg and Robertson, 2000; Semin and Smith, 2008). This Embodied Cognition approach has been gaining more and more support from more and more theorists and researchers however there have been a multitude of claims purporting to represent an embodied account of cognition.

The roots and inspirations for the development of embodied approaches can be seen to be spread through a number of different areas. Clark (1999) used three different examples to express just how varied embodiment is and how far it can stretch. The first example used was that of the Bluefin tuna. The Bluefin tuna was noted to have insufficient physical attributes to execute the abilities it was seen to posses, such as its ability to turn sharply and accelerate quickly. Using an embodied approach an understanding was reached as to just how the Bluefin was able to do the things it could do. Fluid dynamicists claimed that the fish used its own bodily actions to manipulate

its environment thus allowing it to swim faster and turn sharper (Triantafyllou and Triantafyllou, 1995).

Robots were also used as an example of the varied nature and reach of embodiment theories. The robots built by Raibert and Hodgins (1993) utilised a design of balancing by hopping using one leg, which to get moving involved solving a control problem that was impacted by mechanic issues. The most important parameters included resting length of leg spring and also the degree of sideways tilt experienced by the robot, both of which would need a shift towards embodied perspective to be fully understand and executed properly. It was expressed that the controller has to know how to exploit dynamics of the system instead of relying on feedback from a central command. Clark (1999) also argued that this method of utilising embodiment could also be ported to action routines in human infants and adults.

Areas of vision research such as animate and interactive vision (Ballard, 1991; Churchland et al., 1994) were other examples used by Clark (1999). It was noted that the key insights of the research were that the execution of vision did not build rich inner models, instead visual information was utilised in a manner that allowed service in a real-word, real time situation. This insight in turn rejecting a more traditional approach in the field of artificial intelligence (Churland et al., 1994) which claimed vision as being a way of creating a world model that was enough to allow us to disregard the actual world around us and focus on inner models. It was evident that this approach to vision viewed it as highly active and intelligent rather than a passive creation of an inner element.

Clark (1999) discussed two distinct kinds of embodied approaches to cognition. The first of these was termed simple embodiment, this utilised the framework of the traditional disembodied cognitive approaches with facts of embodiment acting as constraints. The second approach discussed by Clark (1999) was radical embodiment, this approach to embodiment is seen as a more controversial take on cognition as it states that embedded facts profoundly alter subject matter and the theoretical framework of cognitive science. Radical embodiment therefore rejects the frameworks and theories proposed by the traditional disembodied views.

With regard to literature and simple embodiment interactive vision literature has shown how the approach could be utilised, the work on interactive vision relies on internal representations, computational transformations and abstract data structures (Ballard, 1991; Ballard et al., 1997). Within this field exists talk of inner data bases of internal feature representations of high-dimensional feature vectors, roles of the body are used as a methodological tool used to get the internal data structures and operations right.

This is evident when looking at the work of Mataric (1992), it concentrates on inner representational resources and explores how the guidance of real world action can inform and constrain inner representations and processing. Within the literature surrounding embodied perspectives the majority of the focus has been upon radical embodiment, this Clark (1999) stated was because of the excitement surround the striking claims made by radical embodiment.

Another example of the adoption of a simple embodiment perspective is the work of Barsalou (1999) on his Perceptual Symbol System. This perceptual symbol system (PSS) proposed by Barsalou (1999) utilised a similar functional nature to that of the traditional cognitive symbol theories (Newel and Simon, 1976; Newell, 1990; Fodor, 1998) however there was a huge difference in the nature of the symbols that were proposed.

As noted earlier within the traditional cognitive theories, symbols were proximal representations of an object that had cognitive activities directed towards it. The key difference between the traditional theories and Barsalou's (1999) is seen when looking at the systematic morphological relationships between the symbols and the experiences of the object.

Within a traditional perspective that utilises amodal symbols there would be no systematic morphological relationship between the experience of something and the perception of that object in cognition. However the perceptual symbols system viewed symbols as being analogical in which the symbols identified with the representation. Within the PSS the object undergoes a systematic mechanical transformation from its recognition from the sensory to the internal code.

Barsalou (1999) made three proposals within his perceptual symbol system, the first of these were that perceptual symbols were not recordings, they were combinations of neural activities that were induced by a perceptual state. This was not limited to visual stimuli or states, it was fully inclusive of all perceptual states and experiences. The second proposal that was put forward was that perceptual symbols that were extrapolated for objects or events were put together in a structure that contained more perceptual symbols for that same object or event that had already been experienced previously. It was also proposed that a simulation is a product of a combination of perceptual symbols that together with their respective frame relationships, produce a potentially infinite set of concepts. It can be noted therefore that the PSS, its frame and simulations proposed by Barsalou (1999) are in actuality commentaries on how experiences become memories.

When looking at radical embodiment it is important to note works by individual's such as van Gelder (1995), Thelen and Smith (1994), Kelso (1995) and Varela et al. (1991). Three fundamental claims can be seen to be evident when viewing such works, the first of these exists in the sense that understanding a complex interplay such as that of the brain, body and world would require a new analytic tool and new methods. The second fundamental claim from these theories of radical embodiment was that the traditional approaches to cognition, such as the internal representations and computational approaches, were inadequate and therefore unnecessary. The third of the claims put forward was that the typical decomposition of cognitive systems to a plethora of neural or functional systems and subsystems was misleading and blinkered researchers to alternative explanations or interpretations.

An idea that can be seen to link closely with these claims was that of the subject matter of cognitive science needing to be re-thought. This argument hinged around the reasoning that a mature science of the mind should not only target the individual or their inner organisation of

intelligence, but should also include the environment and bodily elements that facilitated adaptive success (Clark, 1997; Brooks, 1991;Hutchins, 1995)

It is important to consider these claims and assess any support that they may have. It can be noted that there is some support for the fundamental claims made in regard to radical embodiment when looking at infant motor development(Adoplh, 1995; Adolph, 1998), adult motor actions (Turvey and Carello, 1995; Kelso, 1995) and mobile robotics(Chiel and Beer, 1997; Arkin, 1998; Brooks, 1991,Raibert and Hodgins, 1993). Support from these works are gathered in such a manner that they display non-computational, representation free solutions that are open to dynamical analysis.

Clark (1999) also noted that the third claim made by radical embodiment theorists was shown to be a good prospect. Citing the example of Ballard et al.'s notion of deictic pointers, Clark (1999) noted that Ballard et al.'s suggestions of the external world being analogous to computer memory and also changing gaze being analogous to changing memory reference in a silicon computer, depicted cognition as literally being spread across the neural bodily and environmental elements.

Even if one was only to consider the claims made within the work of Clark (1999) it is clearly evident that the emerging area of embodied cognition has an abundance of claims from an abundance of researchers and theorists. It should therefore be important to not become too enamoured with each and every claim but to assess each one and investigate those which appear to garner support and those that become more prominent.

Wilson's (2002) review provided an account of the six most prominent claims within an embodied perspective. The first claim discussed by Wilson (2002) was that within an embodied cognition perspective cognition is situated, that is cognition is situation bound. This claim has been documented within an abundant amount of literature (Chiel and Beer, 1997; Clark, 1997; Steels and Brooks, 1995). The claim of cognition being situated views cognition as taking place in context of task relevant inputs and outputs. While a cognitive process is being undertaken perceptual information continues to come in affecting processing, with motor activity being executed that would affect the environment in task-relevant ways.

Wilson (2002) argued that when viewed from an evolutionary sense situated cognition could be the bedrock of human cognition. The survival nature of our mental abilities depended on if they were helpful in acting in a direct response to immediate situations like gathering food from the environment or avoiding dangerous situations. Therefore situated cognition could represent humans fundamental cognitive architecture.

Although it has been argued that this view has been somewhat exaggerated, especially when looking at fossil records in relation to gathering food (Leakey, 1994). It could also be argued that to focus on situated cognition as the fundamental part of the human cognitive architecture would be to ignore, or at the very least to neglect, species defining features of human cognition (Wilson, 2002).

There are some arguments however that counter the criticisms of focussing on situated cognition. Barasalou (1999) claimed that language was used by humans initially for immediate indexical purposes. The situated uses of language by early humans had the intention of influencing others during activities like hunting or gathering. Brooks (1999) took an evolutionary stance and claimed that due to non-situated cognitive abilities emerging later in the evolutionary history of animal life, they were easy problems for evolution to solve and thus of no interest to theoretical explanations.

The second claim that Wilson (2002) explored was that of cognition being time pressured. It was noted that there is a wealth of research that depicts cognition as being dealt with in the constraints of real time (Brooks, 1991; Pfeifer and Scheier, 1999). Within the field of robotics and artificial intelligence it was traditionally held that internal representations were allowed to build up and be manipulated when the AI or robot saw fit. However it was noted that within a real world setting, animals or other beings would not have such a luxury.

When looking at the situated cognition literature it is evident that the claim of cognition being time pressured shaped much of it. Through fields of robotics there have been robots built that perform tasks such as navigating uneven terrain (Quinn and Espenschied, 1993), swinging from branches (Saito and Fukuda, 1994) and navigating cluttered environments (Mataric, 1991) all of which required real time responses to feedback within their environment. From this it was argued that greater cognitive complexity could be built up using layers of procedures for realtime interactions with environments (Wilson, 2002).

The focus on time pressures in the area of shaping cognition can also be seen when looking at human behavioural research on situated cognition. The work of Kirsh and Maglio (1994) investigated the procedures that people use when making time pressured spatial decisions when playing the video game Tetris. Their research used the assumption that the playing of Tetris would provide such situations that are a microcosm that displays the basic foundations of human cognition. One source of reasoning behind time pressure having such an effect on cognition is the creation of a representational bottle neck, this bottleneck effect is noted when situations require fast and continuous responses leading to there not being sufficient time to build a full mental model of the environment to build a plan to deal with the situation. It was argued that to be a situated cognizer the use of efficient tricks to generate situation appropriate action is required, this could therefore take real time situated action as the starting point for cognitive activity (Wilson, 2002).

An effective way of illustrating this distinction of real time cognising would be to look at the outfielder problem. This problem is popular within cognitive psychology and seeks to explain how an outfielder positions themselves to catch a fly ball. Traditional cognitive approaches attempted to explain this by using complex complications of the arc the ball takes in the air, the acceleration and also the distance it travels. However if this problem is looked at using a situated time pressured perspective on cognition it becomes much simpler.

Rather than using a complex series of computations and equations to plot the end location of the ball, the outfielder simply adjusts their run so the ball never appears to curve towards to ground. The fielder ensures that the ball moves only in a straight line in their visual field, using this strategy guarantees the fielder to be in the right place to catch the ball (Clark, 1999). When looking at the outfielder problem from an embodied perspective it would stand to reason that this approach was more suited to provide an explanation. This is evident when factoring in the representational bottle neck noted earlier.

With the more traditional approaches taking a more linear route to explain the problem, such as perceive, compute and act. As mentioned earlier, this linear approach would require fast and continuous computations and responses to the ball and its flight path, leading to the assumption that there would be insufficient time to build up a full mental model of the environment and every possibility of where the ball would land.

The third claim outlined by Wilson (2002) explored the notion that individual's offload cognitive work on to the environment. In order to deal with the representational bottleneck that individual's face when confronting tasks it was claimed that individuals reduce cognitive load by utilising the environment in strategic ways. The process of off-loading work in to the environment involves leaving information out in the environment to be accessed when it is needed, instead of fully encoding information in to the brain, then the use of epistemic actions (Kirsh and Maglio, 1994) would then change the environment to facilitate the reduction of the cognitive work that remained.

Work to investigate the process and plausibility of offloading work on to the environment has been conducted and found some promising results. Kirsh and Maglio's (1994) Tetris study can be seen to provide some evidence for the process of offloading on to the environment, the data from their study suggested that individuals that played the game used actual rotations of the blocks to solve the problem rather than constructing a mental computation to solve the problem. Ballard et al. (1997) also provided evidence in support of this claim. Their recording of eye movements when performing a time pressured block arranging task showed repeated referencing of block within a model pattern occurring at strategic moments.

Ballard et al. (1997) claimed that this was a minimal memory strategy showing the most commonly used strategy amongst participants. Glenberg and Robertson (1999) also provided some empirical evidence for the offloading to the environment. They studied participants undergoing a compass and map task, it was found that the participants that were allowed to link written instructions to objects within the environment during a learning trial performed better than the participants that were not allowed to do so.

So far the literature mentioned in relation to offloading work to the environment in order to reduce cognitive load has only focussed on spatial tasks, it is important therefore to look at if this claim is limited only to spatial tasks or if it is applicable to a wider array of cognitive strategy. Wilson (2002) argued that off loading reaches far beyond just spatial tasks and cited activities such

as drawing venn diagrams and doing maths with pencil and paper. It was argued that such activities were both situated and spatial as they involve a manipulation of spatial relationships amend elements of the environment and were advantageous due to actual physical manipulations saving cognitive work.

Leading on from the third claim Wilson (2002) discussed the claim that the environment is part of the cognitive system. This fourth prominent claim from embodied theorists can be noted as one of the stronger claims to come from embodiment theorising. The crux of this claim is that cognition is not an activity of the mind, yet it is distributed across the entire situation including mind, body and environment (Beer, 1995; Greeno and Moore, 1993; Thelen and Smith, 1994). As this claim focusses on cognition not residing solely within the mind it is imperative to study the situation and situated cognizer together in order to properly understand cognition.

Wilson (2002) noted that at least part of this claim was true and that causes of behaviour are surely distributed across mind and environment. It was argued that using the reasoning of causal control being distributed across the situation was not sufficient enough justification to focus research solely on studying a distributed system. Wilson (2002) also argued that distributed causality was not sufficient enough to sustain an argument for distributed cognition, it was also argued that it was important that a full understanding of the kind of system needed. Wilson (2002) reviewed a number of systems theorists to establish the kind of system needed to provide a stronger case for the plausibility of a situated cognition theory.

Wilson utilised a scientific approach to the development of systems to come to the conclusion that a cognitive system would need functional relations amongst its elements, in which these would change every time the individual would be in a new location or performing or interacting with a new set of objects. Therefore the system would retain its identity so long as the situation or the task orientation did not change.

This would be known as a facultative system, one that arises and disbands continuously during the changing of the individual's daily interactions. The comparison was made between this system and that of a system that included a mind only cognitive architecture and a stark difference was noticed. Using an open system that continuously receives inputs, which in turn affect the functioning and production of outputs, would be free from the compromising nature of the system that utilises only the mind.

Moving on from the criteria of the system needed to facilitate a situated approach to cognition another prominent claim was assessed. This was the claim that cognition is for action. The embodied approach to cognition allowed for the consideration of cognitive mechanisms in terms of functional adaptive activity (Franklin, 1995). The claim of cognition being utilised for action gained support from perception and memory work.

When looking at the traditional cognitive work done on visual perception it was assumed that an internal representation was built up of the perceived world. Within the traditional approach the ventral and dorsal visual pathways were seen as the "what" and "where" pathways. These

generated representations of the objects structure and spatial relationships (Wilson, 2002). Research however has seen the dorsal stream thought of more as a “how” pathway, thus the proposed function of this pathway changed to be seen as more of a server to visually guided actions (Jeannerod, 1997).

Certain kinds of visual input have been found to prime motor activity. Craighero et al. (1996) found that viewing a rectangle of a particular orientation would facilitate performance on a grasping task. Motor neurons in monkeys have also been seen to serve as support for such a claim of cognition being for action. It was noticed that some motor neurons within monkeys that are of use in controlling the use of tools are also responsive to seen tools with out any motor response (Grafton et al., 1997). Behavioural research has also shown a facilitation of performance on tasks where object and hand orientation is the same (Tucker and Ellis, 1998).

A similar approach was adopted to the study of memory. Glenberg (1997) saw the traditional approach to memory and memorising as needing to be replaced by a view that identifies memory as being the encoding of patterns of possible physical interactions. In this view of memory short term memory would not be seen as a memory system but as a deployment of action skills. Semantic memory and concept formation are also viewed in similar ways within an embodied memory perspective. Approaching memory in such a way allows for the understanding of how objects and situations are conceptualised in terms of their functional relevance. Wilson (2002) argues that ultimately cognition must be for action as adaptive behaviour that promotes survival must have driven evolution of cognitive architectures.

The final claim that Wilson (2002) analyses is that off-line cognition is body based. This claim resonates with earlier literature that assessed how individuals manipulate their environment to help solve a problem. It was noted that a lot of allegedly abstract cognitive activities could actually use sensorimotor functions in a more covert manner. Structures that originally evolved for perception or action were noted to be co-opted to run off line (Wilson, 2002) and therefore decoupled from physical inputs and outputs. The general function of these sensorimotor processes was to run simulations of parts of the physical world allowing for representation of information of to draw inferences.

The claim of off line cognition being body based has gathered evidence from a growing amount of areas of research over the past few years. Research in to mental imagery (Farah, 1995; Kosslyn et al., 1999), working memory (Wilson and Emmorey, 1997;1998), episodic memory (Wilson, 2002), implicit memory (Wilson, 2002) and reasoning and problem-solving (Glenberg and Robertson, 1999; Barsalou, 1999) have all established the plausibility of off-line embodiment in relation to cognition. It is important to note the wide range of areas that these domains have all covered add to the efficacy of accepting or at least further investigation of the embodied approach.

The Elaboration Likelihood Model

Novel studies in the field of embodied cognition have provided some interesting results. Some of the most interesting findings come from studies that have investigated the psychological mechanisms that influence attitudes. The Elaboration Likelihood Model (ELM) of persuasion (Petty and Cacioppo, 1981,1986; Petty et al., 2002; Petty and Wegener, 1999) was such a model that has seen more and more empirical support in recent years.

First it is important to understand what the ELM specifies. The ELM specifies that there are several discrete mechanisms that can facilitate a change in attitude and that the processes operate at different points during elaboration. Processes can also range from little to no thought regarding attitude toward the object to complete thought about attitude towards the object. It was claimed that bodily movements also had the ability to affect one or more underlying processes.

The ELM specified five processes that bodily movement could affect to influence attitude, the first of these was affecting a process in the way that the amount of issue-relevant thinking occurring is altered. The second was the production of bias towards the thoughts that come to mind. The third influence was the affect to structural properties of the thought, such as confidence in the thought. The fourth process that bodily movement could affect would be to affect attitudes that would be serving as persuasive evidence, such as altering a particular argument towards or against something. The final underlying process bodily movement could affect was that of those processes that serve as peripheral cues to change.

The ELM argued that understanding all of those processes and the process in which bodily responses affect them is important. This was argued to be because when behaviour influences attitudes during low thinking processes the attitudes formed are less persistent, less resistant to change and are also less predictive of subsequent behaviours (Brinol and Petty, 2008). Therefore it can be argued that identifying the processes that facilitate the change or affect of attitudes from bodily movement is informative about consequences of persuasion (Petty et al., 1995).

The ELM specified certain mechanisms that were evident in the process of bodily responses affecting attitudes. The first of these mechanisms was in the form of bodily responses serving as simple cues. The ELM claimed that the body has the ability to affect attitudes by providing a simple cue when thinking about an attitude object is seen to be low. Past research has shown that this claim is certainly plausible, work in to association (Cacioppo et al., 1992) and heuristics (Valins, 1966, Kovecses, 2000,2002) provided empirical support showing the body to affect attitudes.

Another mechanism in which bodily responses can affect attitudes was through basic associative processes and evaluative conditioning. Unconditioned stimuli that are encountered by an individual along with stimuli that are already conditioned to elicit either a positive or negative

response, the stimuli that were in the first instance neutral become either positive or negative dependent on the already conditioned stimuli.

Research in to these basic associative processes is abundant. Cacioppo et al. (1993) found that arm flexion had an association with positive and negative attitude change. It was found that arm flexion, an approach behaviour, facilitated a more positive response than arm extension, an avoidance behaviour. In a similar study, Priester et al. (1996) also found that arm flexion facilitated more positive responses to neutral non-words compared to the responses from arm extension. The research is not limited to just arm flexion or extension. Petterson et al (1991) found that participants that moved their head in a nodding motion, as opposed to a shaking motion, elicited more preference for a previously neutral object.

Research has also investigated facial and postural feedback drawing similar conclusions. Stepper (1988) also found that when smiling was facilitated, by having participants hold a pen in their mouth, cartoons were judge as funnier compared to when smiling was not facilitated. Marzoli et al. (2013) also found that sun-induced frowning fostered aggressive feelings, this was due to the same facial muscles begin activated when facing the sun as when an individual would frown. The research therefore points towards the conclusion that bodily responses do influence associated evaluations and affective states.

Simple inferences from bodily responses is another area that the ELM covers. This area focusses on how bodily responses can have an affect on attitudes in relation to self perception processes (Bem, 1972). The work by Bem claimed that just as individuals see behaviour of others in context relative to its occurrence and providing information about their attitudes, the same occurs for the individuals own attitude.

Research has also shown that physiological responses from the body can cause a misattribution of attitude towards plausible objects within the environment (Petty and Cacioppo, 1983). If an individual is feeling pleasant they may therefore look to the environment for cues and inferences as to why it is they feel this particular way. One of the more prominent examples of this can be seen when looking at the work of Taylor (1975). By providing female participants with false information about their positive physiological responses Taylor (1975) manipulated the participants in to assuming the positivity they felt was due to the males they were viewing.

Brinol and Petty (2008) surmise that when individuals experience arousal, either positive or negative, they search for some form of explanation and that factors in their current situation are most likely to be used to explain the reactions they are exerting.

Of the various influences that the body can have upon attitude it is argued that one of the most fundamental ways the body can do this is by affecting the amount of thinking a person does. The ELM claims that this is most likely to occur when thinking is manipulated in to being either high or low by other variables. Petty et al. (1995) claimed that when an attitude is formed from a process that required a lot of effort the attitude formed is more likely to be persistent and resistant to change or conflicting attitudes.

An area of research that can be seen to be a good demonstration of this process is that of body postures. Works by such authors as Petty et al. (1983), Petty and Cacioppo (1986) and

Riskind and Gotay (1982) all provide empirical support for body posture and its affect on attitude. However, a more contemporary study by Cuddy (2012) provided a novel insight in to the use of posture and attitude change. Within the study some participants undertook “high power” poses that facilitated confidence, these poses were large, outspread poses making the individual big. “Low power” poses were also used, these saw postures of a slumped nature, seen to facilitate negative attitudes (Riskind and Gotay, 1982).

Cuddy (2012) found that when performed before a mock job interview the high power poses elicited attitude change in a positive manner leading to all the high power participants being chosen for the mock position over the low power participants. It was also found that high power posing caused testosterone levels to increase and cortisol levels to drop, showing a direct relationship between the bodily state and attitude change.

The work of Cuddy (2012) also ties in with another instance in which a bodily response can affect attitudes. Bodily states that infer power have been noted to play a role in affecting attitudes. As seen in the Cuddy study poses that were deemed higher power facilitated confidence and facilitated a successful job interview. Other studies have also found similar results, Lakoff and Johnson (1999) found an association between power and orientation. Work by Schubert (2005) also found the association between an affect on power judgements and orientation, it was found that vertical position and movement that an individual engages in has an affect on attitude. Brinol et al. (2007) also found a link between bodily states and their inference of power, the use of a behaviour based induction followed by the receipt of a persuasive message saw participants attitudes towards the message differ based on their behaviour induction.

The Bodily Experience of Weight

In response to the critiques raised earlier about traditional model of cognition and their ignorance towards the influence of motor systems and the role of the body. It can be argued that this has left a hole within the literature as to the extent that bodily experiences can influence an individuals cognition. Such an area should be deemed important for research as the individuals interaction within their environment stems from their bodily actions and experiences. The embodied approaches acknowledged this (Clark, 1999; Barsalou, 1999,2008) and research appeared to investigate this area with some keen interest.

Within the realms of embodied cognition literature an area of intense interest is the grounding of abstract concepts in physical experiences. Barsalou’s (2008,2010) grounded cognition work rejected the amodal architectures of the traditional cognitive perspectives and sought to explain cognition as being grounded in multiple ways, including simulations, situated action and bodily states. It is important to note, although Barsalou rejected the label of embodied cognition due to not all theorists believing bodily states are necessary for cognition, the work from Barsalou can still be viewed from within an embodied perspective.

There is a wealth of research that provides support for the grounding of concepts. Research in cognitive neuroscience has shown that modal systems become activated when individuals perform tasks that engage memory, knowledge and thought (Thompson-Schill, 2003). Social neuroscience has also demonstrated that both nonhuman primates and humans run simulations in their motor an affective systems when in social situations to comprehend and also engage in social processes (Rozzolatti and Craighero, 2004; Decety and Grezes, 2006).

Resarch within cognitive psychology has also provided a wide range of research that provided empirical support for this embodied/grounded theory. Researches have found that sensory motor variables affect divers tasks that are associated with numerous areas including memory, knowledge, perception, action, language and thought (Glenberg, 1999; Zwaan, 2004; Hegarty, 2004; Wilson and Knoblich, 2005; Barsalou, 2008). Research within social psychology has also added to the discussion. Work has found that the manipulation of bodily states can causally affect cognitive processes (Barsalou et al., 2003; Niedenthal et al, 2005).

Within the literature one branch of research has garnered particular interest. The investigation in to weight and how it can affect judgments and attitudes has provided results that are of particular interest to the present study. Proffitt's (2006) work on perception and the economy of action provided an insight in to how visual perception can be influenced by non-visual factors. The economy of action focusses on how cognition can be altered by the bioenergetic costs placed on the body by the environment they are in. Within the 1995 study Proffitt et al. found that after exercising heavily hills were perceived steeper in comparison to those that did not exercise. The use of heavy backpacks has also shown individuals to judge hills as steeper (Bhalla and Proffitt, 1999).

Jostmann et al. (2009) also demonstrated this effect of weight and an economy of action as participants gave lower judgements when holding heavier clipboards as opposed to lighter ones. Schnall et al. (2010) displayed what they claimed was 'direct evidence for the economy of action.' Within their study they focussed upon the role of increased metabolic demand and the role of glucose. They found that a glucose manipulation influenced participants explicit awareness of a hill slant, this would show that perception of a spatial layout was influenced by energetic resources that were available. Therefore the findings were consistent with an economy of action view.

Proffitt (2006) utilised four separate experiments, the first experiment saw participants amount of effort manipulated via inducing fatigue. Participants that took part were regular runners and were tasked with running their most demanding run, they were also asked to provide judgements on the hill inclines. It was found that the runners provided judgements of the hill being steeper after they had finished their run rather than before.

Within the second experiment participants provided their response via verbal and visual means, it was noticed that the bodily experience of the weighted backpack caused their estimation of hill incline to increase (Bhalla and Proffitt, 1999). The third experiment utilised varsity athletes and undergraduate students all with varying levels of fitness. They were tasked with providing judgements on four hills whilst riding stationary bikes. A correlation was found between the two

measures of explicit awareness and fitness, this indicated that participants that were fitter judged hills to be less steep than participants that were not as fit.

Experiment four saw participants assessing their own health and then making hill incline judgements, a correlation was found between declining health and steeper hill judgements. The work by Proffitt (2006) provided an interesting insight in to the affect of weight on judgements and highlighted an interesting area for future research to pursue.

Jostmann et al. (2009) based his work on the embodied theories of Barsalou (2008) and Semin and Smith (2008). Investigating the use of metaphor (Lakoff and Johnson, 1980) and the grounding of the abstract concept of importance in bodily experiences of weight, Jostmann et al. (2009) provided a novel insight in to just how plausible the embodied approach can be. Utilising a clipboard that could be manipulated to either be heavy or light four experiments were conducted. Results from all four experiments showed that participants within the heavy clipboard condition provided lower judgements that those participants within the light clipboard condition. Therefore signalling that the bodily experience of weight had an influence on their judgements.

These findings fall in line with past embodied research from Proffitt (2006), Brinol and Petty (2008) and also work conducted in to the use of metaphors and their importance to cognition (Lakoff and johnson, 1980; Vankeerberghen, 2006). The Jostmann et al. (2009) study demonstrated the possibility that abstract conceptualisation can be facilitated via bodily experiences, a finding that would have likely been missed if traditional approaches were to be accepted without question.

When looking at the research emanating from the embodied perspective in relation to the effect of bodily experiences it is hard to ignore the results. The ever expanding body of research has demonstrated that the body can have a profound effect upon an individuals judgements and perceptions. With the body being the individuals vessel to experiencing their environment it is important that this area continue to be explored allowing for a greater understanding of the complex interplay between body, mind and environment.

Building upon the findings of Proffitt (2006) and Jostmann et al. (2009) experiment one aims to explore the notion that bodily experience of weight can impact on individuals judgements and responses. Utilisation of similar methods employed by the aforementioned authors will allow for experimental validity to be retained as the methods have proved successful in the previous studies.

Experiment One: Effect of Weight on Lexical Decision Making

Within experiment one the impact of the weighted backpack on ratings, reaction times and amount of errors made were examined. From theoretical perspectives (Clark, 1999; Barsalou, 2008) and past research (Proffitt, 2006; Jostmann, 2009) it was reasoned that the bodily experience of weight would have an affect on participant responses.

Participants underwent a lexical decision task while either wearing a weighted backpack or no backpack. Experiment one aimed to explore three hypotheses. The first hypothesis aimed to investigate the affect of weight on reaction times for words and non words, working on the assumption that reaction time would be significantly slower from participants that experienced the weighted back pack compared to participants that did not experience the weight. Hypotheses two and three also investigated the effect of the weighted backpack on words and non-words but focussed on ratings and amount of errors respectively. Each hypothesis was directional asserting that the bodily experience of weight would have a detrimental affect upon participant responses.

Method

Design

A mixed design was utilised within experiment one. A between subject variable of backpack was studied, with two levels of backpack or no backpack. A within subjects variable of word type was also studied with two levels, word or non-word.

Participants

A total of 32 participants, 12 females and 20 males, were sampled for participation within experiment one. Variables such as age, ethnicity were not recorded and therefore not utilised. Two sampling methods were used for this experiment. The methods used were a volunteer sampling method, where participants were contacted via an email (see appendix A) asking them to volunteer to take part. Participants contacted via email were all either staff or students at The University of Huddersfield, the email gave a brief outline of what the study would require them to do and also details of when and where the study would take place. An opportunity sampling method where participants were gathered that were in close proximity to the location of the experiment. The researcher approached individuals as they were walking by the room of the experiment and asked if they would like to take part. Participants sampled via this method were also likely to be staff and students of The University of Huddersfield.

There were two criteria that participants were screened on. The first screening criteria the participants had to meet was that they had never been diagnosed with Dyslexia, screening took place in the form of verbal questioning. If participants answered yes then they would be thanked for attending and informed that unfortunately they would not be able to participate within the research. As the lexical decision task displayed words and non-words reaction times and amount of errors

made could have been skewed by dyslexia. Other screening criteria the participants had to meet was that they were able to speak and read the English language to at least a basic level.

Materials and Apparatus

Experiment one utilised digital equipment in order to record responses from participants. A Dell computer with 13in monitor were used to display the visual stimuli to participants. Words from the ANEW (Bradley and Lang, 2010) that were deemed to be of neutral arousal were utilised within a lexical decision task and formed 120 trials (see appendix B). The computers that were used in the study all ran the Windows 7 operating system. The software that was used to run the lexical decision task was Superlab Pro 4.5, this software also recorded the responses from the participants. In order to register their responses participants used a standard qwerty keyboard, using numbered keys to register ratings and the q and p keys to register word or non-word responses. Within experiment one participants in one group were given a back pack to allow for measurement of the effect of weight on their responses. The backpack was a Puma backpack containing two 2.5kg York weight plates to ensure that the weight was at least evident to the participants.

Procedure

Upon arrival at the room the study took place, participants were greeted by the researcher. The researcher then asked the participant the screening questions, if the participant conformed to the criteria they were invited in to the room to participate in to the study. The researcher then presented participants with an information sheet (see appendix C) and a consent form (see appendix D). Participants were instructed to read the sheets they were presented with and were then also verbally briefed on what participation in the study would entail ensuring that participants were clear on what was happening. Participants were also informed of their rights within the study and reminded that if at any time they wished to stop they had the right to do so. After the participants had signed the consent form they were randomly allocated to either condition one or two.

Within experiment one participants in condition one underwent a standard lexical decision task with letter strings presented in just one position on the screen, the middle position. After presentation of each letter string participants registered if the string presented was or was not a word by pressing either the Q key if they saw a word or the P key if they saw a non-word. Then participants registered a rating of the word by using a numbered key between one and nine with the scale increasing in positivity from one, very poor, up to nine, very good.

Participants in condition two underwent a standard lexical decision task and also wore a backpack that was weighted with two 2.5kg weight plates. After each letter string was presented the participant registered their response as to if they saw a word or a non-word appear on the screen. To register their response participants used either the Q key, to register the string as a

word, or the P key to register the string as a non-word. Participants then registered their rating of the word by using a numbered key between one and nine, with the scale increasing in positivity from one, very poor, up to nine, very good.

Upon completion of their task in their respective condition the participants were allocated to, participants were presented with a debrief form (see appendix E). Participants were also verbally debriefed and had the full aims of the research fully explained to them. Participants were informed of their rights and that if they wished for their data to be removed from the study that they were fully entitled to do so. Participants were also informed that they were free to contact the researcher at any time in the future to discuss the research and any concerns they may have. After this participants were free to leave the participation room.

Results

Hypothesis one

Descriptive analysis of data gathered on reaction times for words and non-words between conditions indicated that participants that wore the weighted back pack took longer to respond (see table two). A 2x2 mixed ANOVA, assessing the factors of weight and word type each with two levels of backpack or no backpack and word or non-word respectively, was conducted. It was found that there was a main effect of word type ($F=5.127$, $df=1,30$, $p=0.031$ $\eta2=0.146$) but no main effect of condition ($F=3.662$, $df=1,30$, $p=0.065$, $\eta2=0.223$). A significant interaction between word type and condition was found ($F=8.6188$, $df=1,30$, $p=0.006$, $\eta2=0.223$) that showed that the effect of the weight on word type was specifically that it had a detrimental effect on reaction times, more so for non-words (see figure one). As no main effect of condition was found the experimental hypothesis must be rejected and the null hypothesis retained.

Table two: Mean and Standard Deviations for Reaction Times, Ratings and Errors for Words and Non-Words.

	Back Pack Words	**Back Pack Non-Words**	**No Back Pack Words**	**No Back Pack Non-Words**
Reaction Time (ms)	1869.98 (SD 993.50)	2171.91 (SD 1139.92)	1416.61 (SD 721.04)	1377.62 (SD 837.71)
Rating	5.66 (SD 1.05)	4.27 (SD 1.00)	5.79 (SD 0.70)	4.17 (SD 0.90)
Amount of Errors	4.50 (SD 3.74)	6.13 (SD 5.63)	3.88 (SD 3.48)	3.31 (SD 3.76)

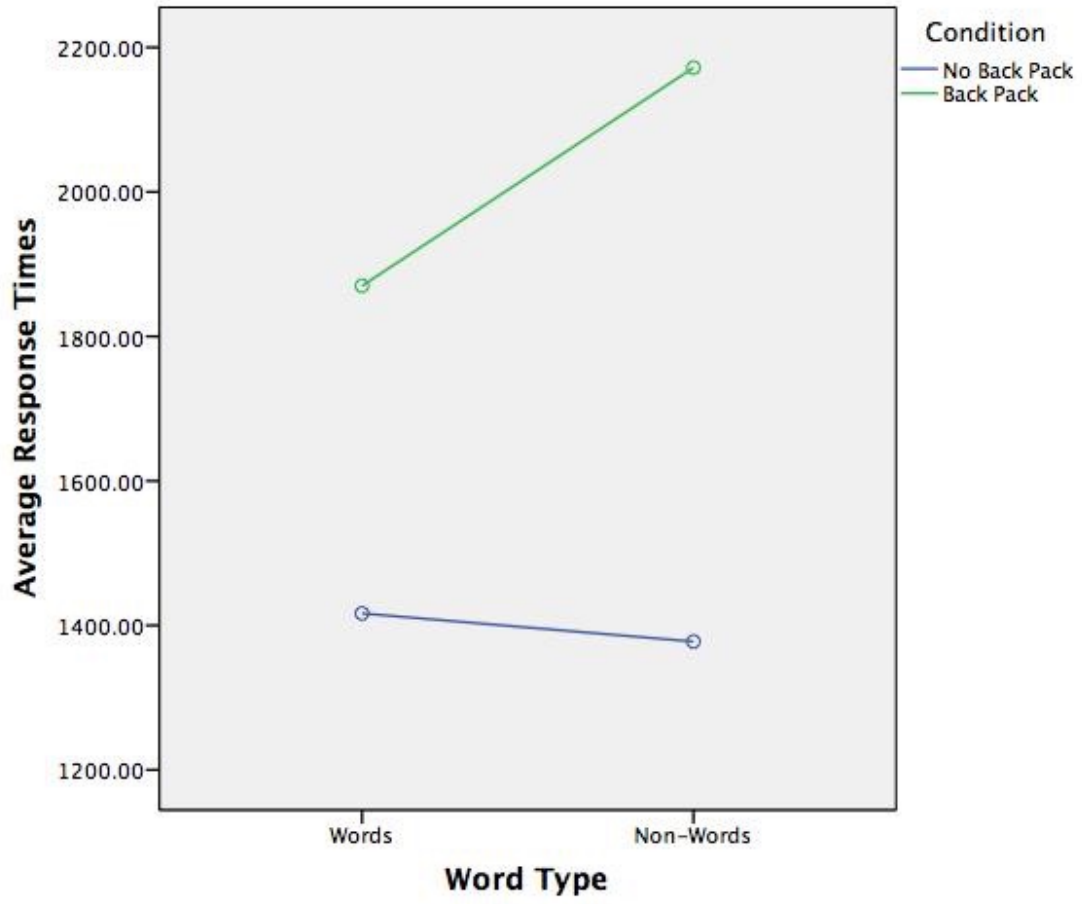

Figure one: ANOVA analysis of response times for words and non-words between conditions.

Hypothesis Two

Descriptive analysis of data gathered on ratings for words and non-words between conditions indicated that it was the effect of word type that influenced results rather than the weighted backpack (see table two). A 2x2 mixed ANOVA was conducted and found that there was a main effect of word type ($F=61.271$, $df=1,30$, $p<0.001$, $\eta 2=0.671$) but no main effect of condition ($F=0.002$, $df=1,30$, $p=0.962$, $\eta 2<0.001$). There were also no significant interactions found between word type or condition (see figure two) ($F=0.361$, $df=1,30$, $p=0.553$, $\eta 2=0.12$). As no main effect of condition was found the results therefore dictate that the experimental hypothesis should be rejected and the null hypothesis retained.

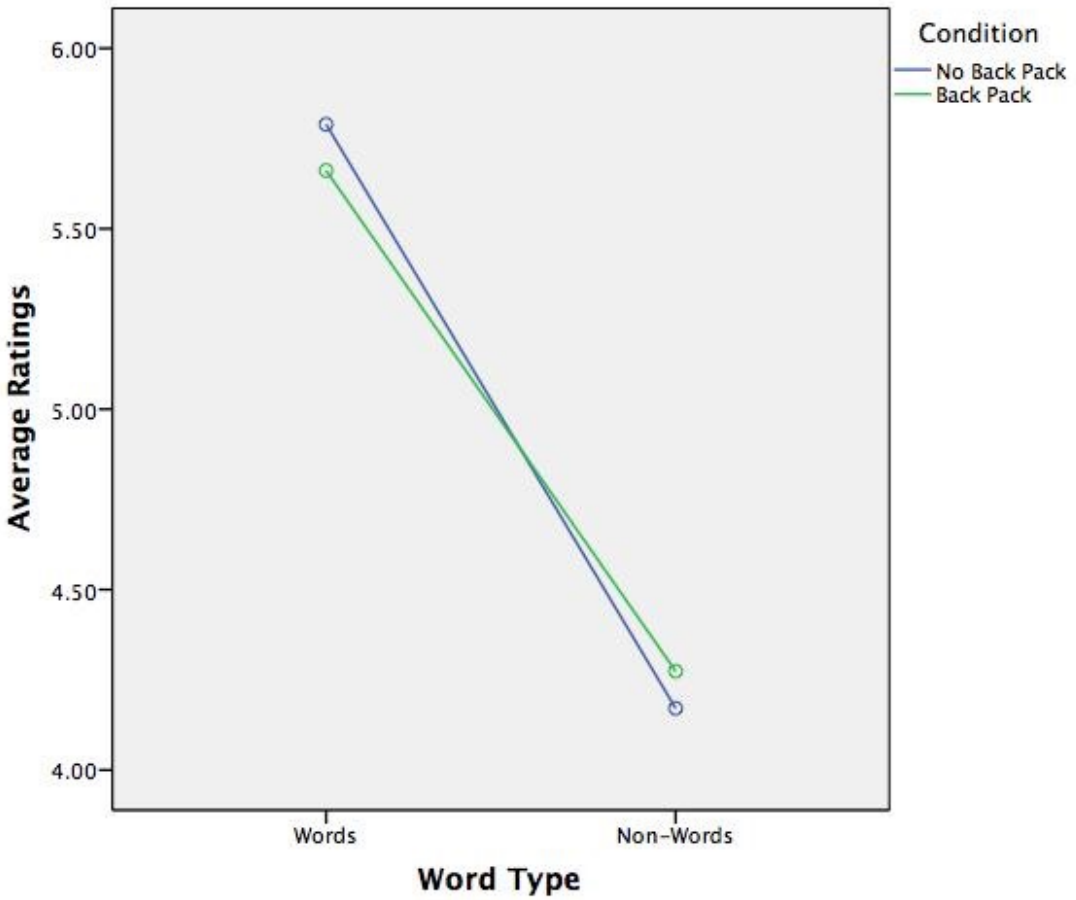

Figure two: ANOVA analysis of ratings for words and non-words between conditions.

Hypothesis Three

Descriptive analysis of data gathered on errors made by participants indicated that participants made more errors whilst wearing the weighted backpack opposed to not wearing the weighted backpack (see table two). A 2x2 mixed ANOVA was conducted and found there was no main effect of word type ($F=0.301$, $df=1,30$, $p=0.587$, $\eta 2=0.587$) and also no main effect of condition ($F=2.038$, $df=1,30$, $p=0.147$, $\eta 2=0.069$). There was also no significant interaction found between word type and condition ($F=2.217$, $df=1,30$, $p=0.157$, $\eta 2=0.069$). As no main effect of condition was found the experimental hypothesis must be rejected and the null hypothesis retained.

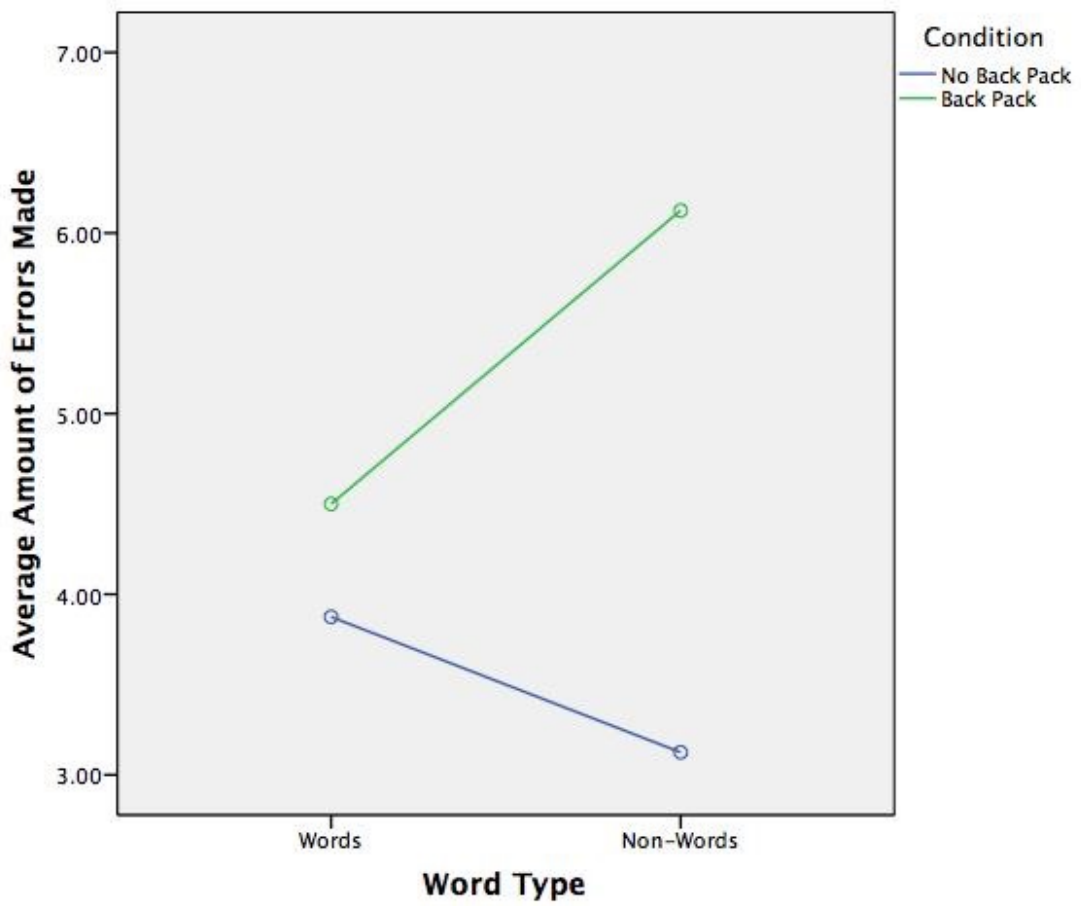

Figure three: ANOVA analysis of amount of errors made for words and non-words between conditions.

Experiment One Discussion

The analysis of the first hypothesis showed a lack of support for the embodied perspective (Clark,1999; Barsalou, 2008) and the claim bodily experiences affect judgements and ratings (Proffitt, 2006; Jostmann, 2009). The findings from the analysis show a contradiction of the past research and asserts that if there was an effect from the weighted back pack it was not sufficient enough to significantly affect participants judgements, reaction times or error rate. It is worth noting however that the mean values for each dependent variable within hypothesis one were consistent with the propositions of Clark (1999) and Barsalou (2008) and also with past research from Proffitt (2006) and Jostmann (2009). However, although the data appeared to be heading in the direction that was predicted the lack of significance did not allow for retention of the experimental hypothesis. Methodological issues and sampling issues relating to sample size could have been a factor in the lack of main effects found.

Analysis of the first hypothesis also showed a lack of support for the effect of bodily experiences of weight (Jostmann et al., 2009) and the economy of action (Proffitt, 2006) in relation to any significant effect on reaction times. However it is worth noting that mean values of reaction times were seen in to support the notions of Jostmann et al. (2009) and Proffitt (2006) however sampling restraints could have been to blame for the lack of a main effect of condition being found.

The analysis of data from the second hypothesis found a main effect of word type. The notion of word type having a causal effect on reaction times could be linked to embodied language comprehension and has been focussed on in past literature (Glenberg and Kaschak, 2002). It should be noted that the effect of word type could be due to the use of a lexical decision task. The findings of faster reaction times when responding to words is a common finding from the use of lexical decision tasks. However, this finding of word type could still prove to be an interesting finding and warrants further investigation. The finding of a significant interaction between word type and condition is also one of interest and needs to be considered further.

Analysis of hypotheses two and three showed a lack of support for past research (Proffit, 2006; Jostmann,2009) as no main effect of condition was found. This indicated that the effect of the weight experienced was not significant enough to effect ratings given. The finding of a main effect of word type provides an interesting area of further investigation and is consistent with past research by Glenberg and Kaschak (2002) and their work in to embodied language comprehension. In this sense then the findings from hypothesis two can be argued to support the embodiment hypothesis (Clark, 1999; Barsalou, 1999;2008).

Analysis of hypothesis two and three also showed a lack of support for embodiment theories (Clark, 1999; Barsalou, 1999;2008) and also past research (Proffitt, 2006; Jostmann, 2009). The lack of a main effect of condition indicates that the experience of weight was not significant enough to influence the amount of errors made on a lexical decision task. The lack of main effects found could be down to methodological issues, such as the weight not being sufficient enough, or sampling issues such as insufficient sample size to provide enough data.

Experiment one utilised 32 participants, this number is lower than previous studies that have found a significant effect of weight on participants (Proffit, 2006; Jostmann et al., 2009). The use of a larger sample size may be needed to provide enough data for significant effect to be found. It should be noted however that within the preliminary analysis it was indicated that the experimental hypothesis could be supported. This was due to the means displaying a pattern that would fall in line with the directions predicted by the hypotheses.

It is important to note however that within experiment one there was a significant interaction found between word type and condition. This significant interaction provided an interesting platform for further investigation. As the interaction was found between word type and the effect of weight it raises the possibility that the words or non-words could have been a factor that influenced responses from participants. It could be possible that the comprehension of the words or letter strings utilised within experiment one influenced the participants and the responses they made. It is important therefore to investigate this possibility. Within an embodied theory of cognition there are different accounts regarding language comprehension that would provide an insight in to the plausibility of the influence of the letter strings. Work by Glenberg and Robertson (1999,2000), Glenberg and Kaschak (2002) and Zwaan (2004) all propose theoretical accounts for an embodied

language comprehension perspective. Experiment two will aim to investigate the possibility of the comprehension of language having an affect on participant judgement and response.

The analysis of experiment one found that there were some main effects and significant interactions between word type and condition. It was noted that the findings of significant interactions would not be predicted by performance on a lexical decision task. Therefore the findings of the significant interactions pose an interesting insight into the possibility of alternate, unexplored processes that could be evident.

The ACE, Language and Embodied Cognition

Another area of particular interest within the present study and also in embodied literature is that of language comprehension. As noted earlier traditionally language comprehension is viewed as a system of symbol manipulation. Within this approach meaning is derived from language by the utilisation of of abstract, amodal and arbitrary symbols combined by syntactic rules (Chomsky, 1980; Pinker, 1994; Fodor, 2000). However, this approach to language comprehension has been challenged by more contemporary theorists and researchers in line with an embodied or grounded approach (Barsalou, 1999,2008; Glenberg and Robertson, 1999, 2000; Stanfield and Zwaan, 2001; Glenberg and Kaschak, 2002). This newer approach to language comprehension claims that meaning from linguistics is grounded within bodily activities.

The Indexical Hypothesis and Immersed Experience Framework

It is first important to consider the propositions from an embodied hypotheses known as the indexical hypothesis (IH) (Glenberg and Robertson, 1999,2000) and the immersed experience framework (IEF) (Zwaan, 2004). The IH builds on an account of embodied cognition that claims that there is a strong possibility of meaning being embodied, thus it utilises the bio-mechanical nature of bodies and their perceptual systems (Lakoff, 1987;Glenberg, 1997; Glenberg and Kaschak, 2002).

The IH also claims that the first step to understanding sentences is the indexing of words and phrases to objects as well as the indexing of analogical representations of objects to perceptual symbols (Glenberg and Robertson, 1999; Weiskopf, 2010). Step two of the IH concerns the acquisition of affordances from indexed objects (Glenberg and Roberston, 2000; Kaschak and Glenberg, 2000) with step three meshing the affordances in to coherent actions (Glenberg and Robertson, 1999).

The IEF views language as a set of cues to construct an experiential simulation of a described situation. Within this framework the individual is an immersed experiencer of the situation with comprehension being the vicarious experience of the situation (Zwaan, 2004). Both

of these claims are built upon the fundamentals of the embodied cognition perspective as they utilise the perspective that cognition is shaped by the bodily capacities and interactions of the individual.

The Action-Sentence Compatibility Effect

Influenced by the works of Barsalou (1999) and Gibson (1979), and building on the work produced by the IH, one of the most notable models of this embodied linguistic approach came from Glenberg and Kaschak (2002). Within their work they proposed the action-sentence compatibility effect (ACE), this effect claimed that merely comprehending a sentence implies action in one direction and this interferes with real action within the opposite direction. Glenberg and Kaschak (2002) cited the example of closing a drawer, the comprehension of the sentence “close the drawer” would then interfere with actions that moved towards the body.

This idea of grounding comprehension in to bodily action is directly inconsistent with the traditional abstract theories within traditional cognitive models (Fodor, 1983,1990). Glenberg and Kaschak (2002) utilised three experiments to test the efficacy of their proposed ACE. The experiments presented participants with a series of sentences that were deemed either sensible or nonsense and were then asked to make a judgement as to whether they made sense. The manipulation of one independent variable to imply sentence direction and the utilisation of a response box allowed for the measurement of the proposed ACE.

The study demonstrated that participants provided faster reaction times when the response and action were consistent with each other. The findings from the study also indicated that the ACE was consistent with the predictions of the IH and also supported the notion of language comprehension being grounded within bodily action. To summarise the findings of the Glenberg and Kaschak (2002) study, the results demonstrated that understanding imperative, double object and dative constructions is grounded in action, the results also raise the possibility of all language comprehension being grounded within bodily action.

Further investigation in to language comprehension has provided more evidence for the plausibility of the ACE. Borghi et al. (2004) found that participants could identify parts of objects faster depending on their spatial and functional perspectives. After reading a sentence with either an inside or outside perspective participants were then queried with either an inside or outside prompt. It was found that participants were 150ms faster to identify inside parts than outside parts thus indicating that the spatial perspective the participants had of the inside parts facilitated their responses.

In a second experiment Borghi et al. (2004) took perspectives whilst inside a car and outside a car and then asked participants to identify parts that would be either near or far from their perspective. The near and far parts would differ with perspective, for example if a participant had an inside perspective a license plate would be a far part, with an outside perspective a steering wheel would be far. It was found that participants were faster to identify parts that were congruent

with their perspective compare to identifying parts that were incongruent with their perspective. Borghi et al. (2004) concluded that participants were constantly running simulations and tapping in to affordances that were derived from perceptual symbols that ground meanings of linguistic symbols.

Investigations by Glenberg et al. (2010) also found that participants responded faster when movement was consistent with actions that were implied. It was claimed that understanding the action sentences utilised the same neural and bodily states involved in real action.

Work by Zwaan and Yaxley (2003) investigated spacial iconicity. They aimed to examine the possibility of spatial iconicity affecting participants judgements on semantic relatedness. Two examples were cited to describe the concept of iconicity, the first was that of onomatopoeia, words that sound the same as their referent. The second noted iconicity could occur at higher abstraction levels in which linear order of words could match the chronological order of words they describe.

The goal of the research was to investigated the possibility of spatial iconicity having an affect on language processing. The relative position of words on a computer screen compared to the relative position of the referent was the method utilised to test this. Zwaan and Yaxley (2003) utilised nouns to denote parts of objects with a vertical spatial relation (e.g branch-root), but did not make reference to spatial location. Words were presented to participants in either iconic order (e.g attic-basement) or reverse iconic order. It was found that when words were presented in reverse iconic order participants provided significantly slower semantic-relatedness judgements in comparison to the iconic condition.

This provided support for the hypothesis that spatial arrangement of words affects their interpretation. The work of Zwaan and Yaxley (2003) provided an interesting insight in to the role of words and how they can impact on judgements. The vertical positioning of the words would influence the participants response, especially when the word positions were at odds with their canonical position of their referents. Consistent with an embodied approach, this study displayed the efficacy of utilising such theories proposed by the likes of Barsalou (1999,2008) and Clark (1999).

Meteyard et al. (2008) explored the area of visual motion and its interference with lexical decision motion words. Participants undertook lexical decision tasks containing ‘up’ and ‘down’ and control words. Three conditions of match, mismatch and control were utilised. Conditions were based on the congruency between the words and their motions. Results found that participants had significantly faster reactions within the match condition in comparison to the mismatch condition.

Further evidence in support of the effect of spatial arrangement of words came from Dunn et al. (2014). Participants underwent a lexical decision task with 120 trials consisting of spoken words and non-words. Words were given either an upward, downward or neutral spatial association. Participants made lexical decisions by fixating upon a target either above or the centre of the screen. It was found that participants responses were faster when word locations were congruent to their spatial location. Participants were found to produce faster responses when hearing a word such as moon, then looking up to confirm that it was a word.

The findings from Dunn et al. (2014) and Meteyard et al. (2008) provide support for the findings of Zwaan and Yaxley (2003). Each of the studies consistently provided evidence for the spatial effect of words and effect on judgements and reaction times respectively. This area of spatial effect upon judgement and reaction times is one of interest to the present study. As results from experiment one displayed support for the possibility of the language comprehension and spatial effects. This can be seen in the production of significant main effects and interactions within the ANOVA analyses. As past research and theoretical perspectives provide some explanation for these phenomena it is important that more empirical data is gathered on the area to further investigate the efficacy of such claims.

Experiment 2A - The Spatial Effect of Words on Judgements, Reaction Times and Error Rates

Within experiment two the impact of spatial position on ratings, reaction times and amount of errors made were examined. Building on findings from experiment one that demonstrated a significant interaction between word type and condition and utilising reasoning put forward by past research (Zwaan and Yaxley,2003; Meteyard et al., 2008; Dunn et al., 2014). Whilst also utilising the ACE (Glenberg and Kaschak, 2002) it was reasoned that words presented on a spatial lexical decision task would affect judgements, reaction times and amount of errors in relation to position of the word on screen.

Utilising a similar methodology as experiment one, experiment two was conducted to examine three directional hypotheses. The three hypotheses explored the possibility that reaction times would be significantly slower, the amount of errors made would be significantly higher and that ratings would be significantly lower when words and non-words were presented within the bottom screen position. It was expected, based on past research and theorising, that the positioning of the words on the screen would influence the responses from participants.

Method

Design

A repeated measures design was utilised within experiment two. Within subjects variables of word type, with two levels of word and non-word and spatial location, with two levels of top and bottom were utilised.

Participants

The sampling of participants for experiment two remained largely the same to that utilised in experiment one. A total of 16 participants were sampled 6 were male and 10 were female, age and ethnicity were not recorded. The sampling methods used within experiment two remained the

same as used within experiment one. Screening criteria also remained the same within experiment two as was used in experiment one.

Materials and Apparatus

The equipment used for presenting stimuli and recording responses from participants remained the same as used within experiment one. The only difference being the lack of a backpack as there were no conditions within experiment two that utilised a backpack.

Procedure

Participants were greeted and presented with relevant forms such as in experiment one. Participants then undertook a spatial lexical decision task with the stimuli being presented at two positions of either high or low. Response input remained the same as experiment one as did the rating scale. Upon completion of the task participants were presented with a debrief from (see appendix E) and were also verbally debriefed. Participants were informed of their rights and that if they wished for their data to be removed from the study that they were fully entitled to do so. Participants were also informed that they were free to contact the researcher at any time in the future to discuss the research and any concerns they may have. After this participants were free to leave the participation room.

Results

Hypothesis One

Descriptive analysis of the data for reaction times regarding words and non-words on a spatial lexical decision task indicated that participants were faster to respond when word position was at the bottom (see table three). Preliminary analysis also indicated that participants were faster to respond to words rather than non-words (see table three). A 2x2 repeated measures ANOVA was conducted and found there to be no main effect of position ($F(1,15)=0.306$, $MSE=70623.349$, $p=0.588$, $\eta 2=0.020$). The ANOVA did find a main effect of word type ($F(1,15)=16.007$, $MSE=3602325.08$, $p<0.05$, $\eta 2=0.516$) however no significant interaction between position and word type was found ($F(1,15)=0.662$, $MSE=52177.378$, $p=0.429$, $\eta 2=0.042$). As no main effect of position was found the experimental hypothesis was rejected and the null hypothesis retained.

Table Three: Mean and Standard Deviations of Response Times in ms on A Spatial Lexical Decision Task

	Top Position	**Bottom Position**
Word	2228.47 (SD 997.72)	2219.14 (SD 936.06)
Non-Word	2760.07 (SD 1291.24)	2636.53 (SD 1214.10)

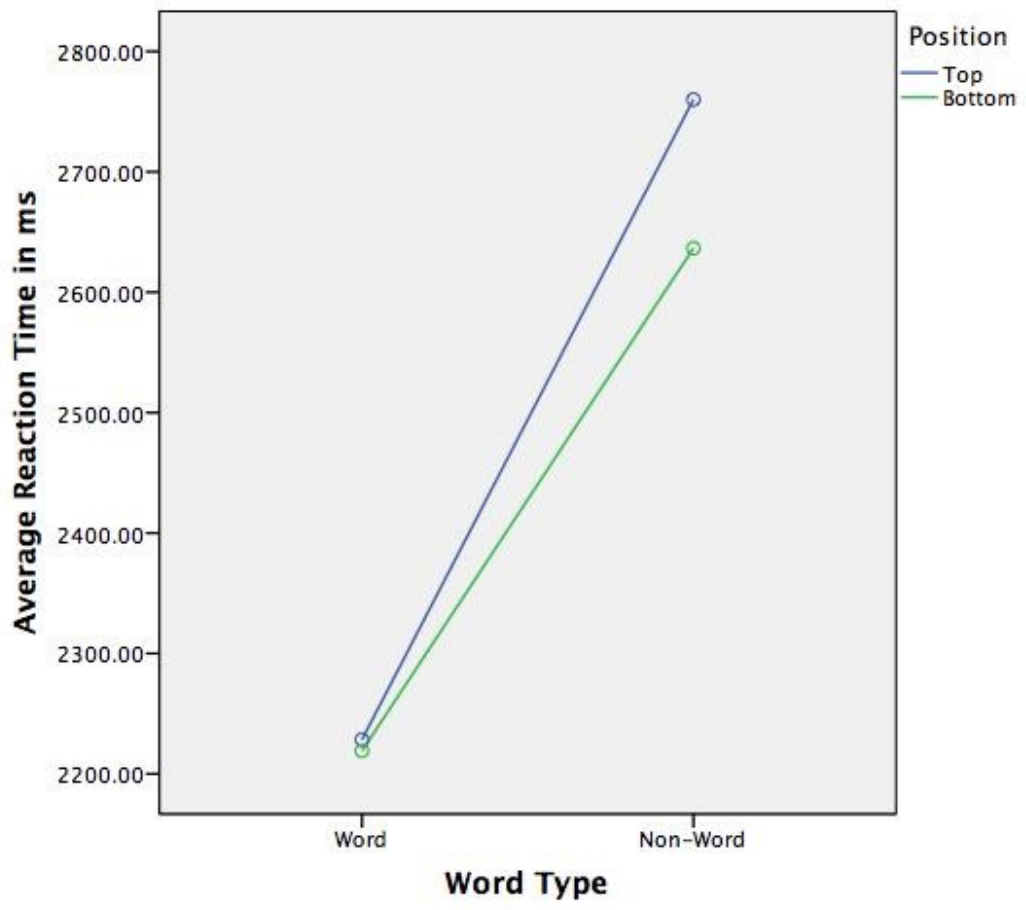

Figure Four: ANOVA analysis of reaction times for the spatial lexical decision task.

Hypothesis Two

Descriptive analysis of data for ratings on the spatial lexical decision task indicated that participants gave less harsh ratings when viewing words rather than non-words (see table four), it also appeared that the position of the letter strings had little to no impact on participant ratings (see table four). A 2x2 repeated measures ANOVA was conducted and found that there was no main effect of position on ratings ($F(1,15)=0.129$, $MSE=0.011$, $p=0.724$, $\eta 2=0.009$). It was found that there was a main effect of word type ($F(1,15)=28.854$, $MSE=144.715$, $p<0.001$, $\eta 2=0.658$) and that there was also a significant interaction between position and word type ($F(1,15)=4.724$, $MSE=0.275$, $p=0.046$, $\eta 2=0.239$). Although a main effect and a significant interaction was found, due to there being no main effect of position on ratings the experimental hypothesis was rejected and the null hypothesis retained.

Table Four: Mean and Standard Deviations of Ratings on A Spatial Lexical Decision Task

	Top Position	**Bottom Position**
Word	7.15 (SD 1.55)	7.30 (SD 1.59)
Non-Word	4.27 (SD 1.49)	4.17 (SD 1.47)

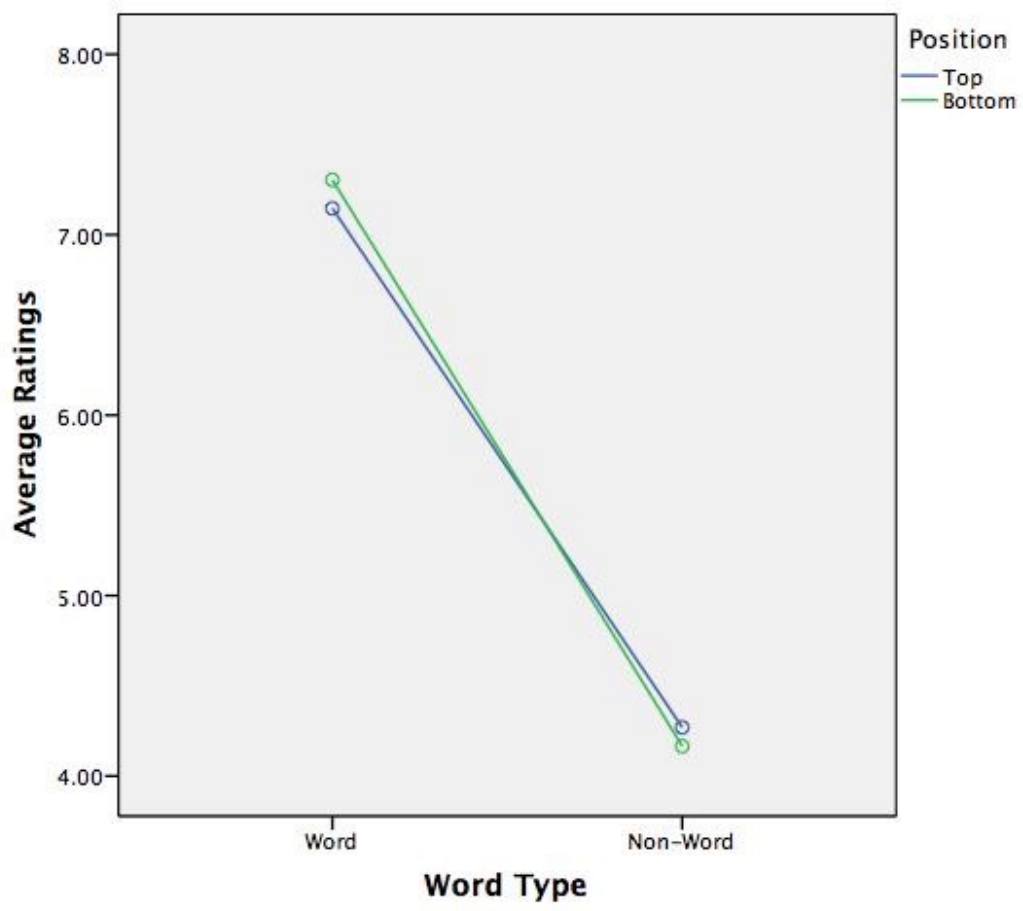

Figure five: ANOVA analysis of ratings from the spatial lexical decision task

Hypothesis Three

Descriptive analysis of the data for amount of errors made on the spatial lexical decision task indicated that participants made more errors when responding to non-words rather than responding to words (see table four). It was also indicated that there was little to no effect of position in regard to amounts of errors made (see table four). A 2x2 repeated measures ANOVA was conducted and found that there was no main effect of position ($F(1,15)=0.714$, $MSE=1.400$, $P=0.411$, $\eta 2=0.045$) and also no main effect of word type ($F(1,15)=1.827$, $MSE=41.896$, $P=0.196$, $\eta 2=0.109$). The ANOVA also found that there was no significant interaction between position and word type ($F(1,14)=2.094$, $MSE=1.463$, $P=0.168$, $\eta 2=0.123$). As there was no main effect found of position on the amount of errors participants made the experimental hypothesis was rejected and the null hypothesis was retained.

Table Four: Mean and Standard Deviations of Amount of Errors Made on A Spatial Lexical Decision Task

	Top Position	**Bottom Position**
Word	1.06 (SD 1.29)	1.25 (SD 1.81)
Non-Word	3.69 (SD 1.49)	3.00 (SD 5.48)

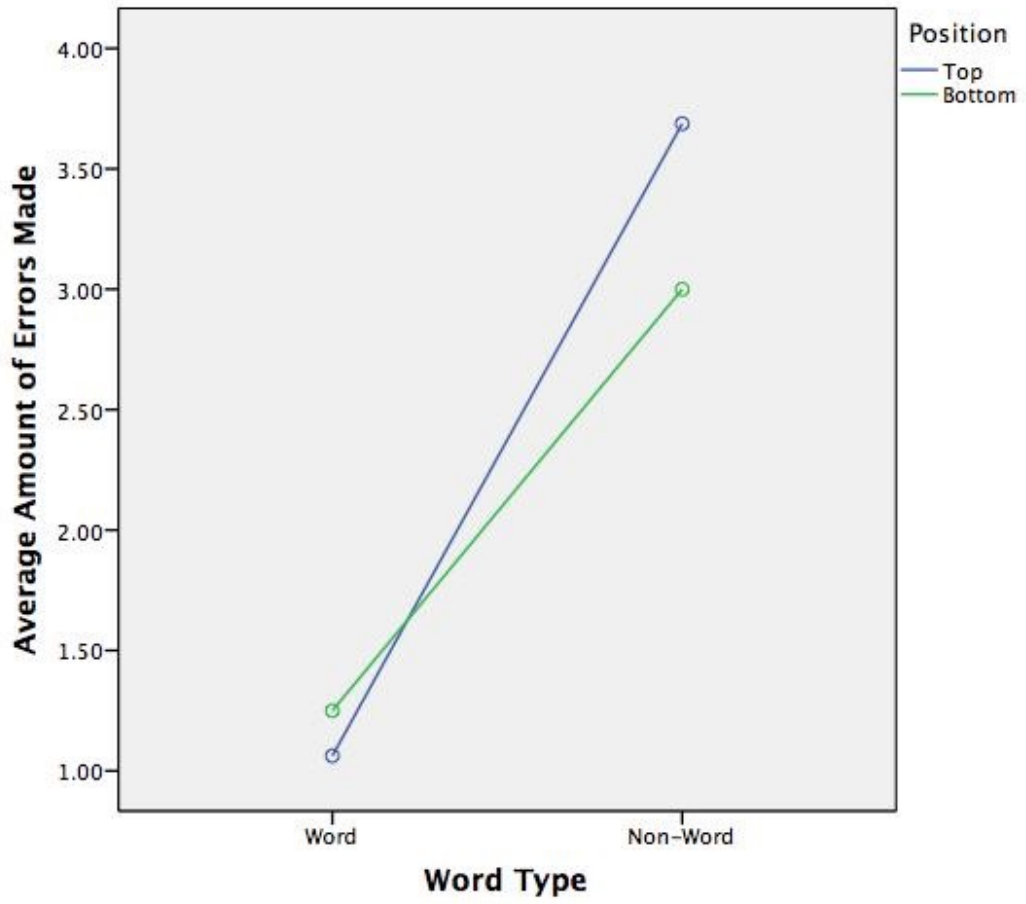

Figure six: ANOVA analysis of amount of errors made on the spatial lexical decision task.

Experiment Two Discussion

Analysis of the first hypothesis lead to the experimental hypothesis being rejected and the null hypothesis retained due to no main effect of position being found. This would lead to the conclusion that this provides a lack of support for past research (Glenberg and Kaschak, 2002; Zwaan and Yaxley, 2004; Meteyard et al., 2008; Dunn et al., 2014). However it is important to note that within the first hypothesis analysis a main effect of word type was found. This finding of word type shows a consistency between experiments one and two within the present study. This finding of a main effect of word type also demonstrates a consistent finding from past literature that has utilised a lexical decision task.

Analysis of the second hypothesis also lead to the experimental hypothesis being rejected and the null hypothesis being retained as there was no main effect of position found. It is interesting to note though that there was a main effect of word type and also a significant interaction between position and word type found within the analysis. The findings of a main effect of word type can be argued to be considered to be consistent with work from Glenberg and Kaschak (2002) as the sensibility of the letter string could have been the cause of the main effect being found. It is also of interest to consider the significant interaction that was found, this

interaction suggests that the size of the effect of position is dependent on the word type that is presented.

Analysis of the third hypothesis also lead to the experimental hypothesis being rejected and the null hypothesis retained due to the lack of a main effect of position being evident. No main effect of word type suggesting that the effect of word type does not depend on position with regard to the error rate a participant would encounter. The lack of a significant interaction between position and word type would also indicate that the effect of position is not dependent on the word type presented to the participant. The findings from hypothesis three show a lack of a distinct effect from hypotheses and models such as the ACE, IH and IEF, however it should be considered that the descriptive analysis provides some room for the consideration of a subtle effect being evident.

Methodological restraints on experiment two could have had an impact on the results obtained. Sample size restraints could have had a detrimental impact on results in the form of not having a suitably representative sample of a wider population, this could be easily corrected within future research. It could also be argued that a latency effect could have been evident due to the non-words being quite close to resembling words (Luper and Pexman, 2010).

It has been noted in past research that the more word-like the non-words are within a lexical decision task the more likely an increase in latency effect becomes. Stone and Van Orden (1993) also reported that this similarity between words and non-words could drive an increase in larger word frequency effects therefore words could be reported more frequently due to participants judging non-words to be words due to similarity.

Experiments within this study utilised words and non-words that were similar to one another, non-words were created by rearranging letters within recognisable words. This could have lead to the effects reported by Luper and Pexman (2010) and Stone and Van Orden (1993) which could also explain the rejection of hypotheses.

Within both experiments conducted this far it is of interest to note that significant interactions have been found. When considering theories of embodiment (Barsalou, 1999,2008; Clark, 1999; Glenberg and Robertson, 2000; Semin and Smith, 2008) it is evident that there is an amount of interaction between systems of the body to facilitate cognition. Studies have shown that the motor systems interact with the cognitive systems to provide feedback and form individual attitudes and influence responses (Proffitt, 2006; Jostmann et al., 2009), studies have also shown the sensory systems interacting with the cognitive systems to influence perception (Borghi et al., 2004).

What has not been studied is the possibility of the interactions between different embodied systems and a cohesion effect between the two systems. If the motor and sensory systems were activated simultaneously to provide feedback to the cognitive system, would one of the systems become dominant or would there be a mutual facilitation of systems to provide richer feedback to the cognitive system?. It is this question that experiment 2B aims to investigate.

Experiment 2B - Exploring the possibility of a Dominance Effect within Embodied Systems

To understand the rationale behind experiment 2B it is important to go back and look at the fundamental claims of the embodied perspective. Barsalou (1999,2008) claimed that cognition was grounded within bodily experiences, simulations and situated action. Barsalou's claims display an interaction between multiple bodily systems along with the cognitive systems to provide a single cognition for the individual.

Clark's (1999) work on embodied cognition also displayed a similar approach to Barsalou as the simple embodiment put forward by Clark (1999) displayed the retention of the traditional approaches framework but also incorporated bodily elements, showing the possibility of an interaction between the two. The radical embodiment proposed by Clark, although it rejected the traditional notions of internal representation and computation, did acknowledge the interplay of the brain, body and world. It appears therefore that the notion of interaction and interplay is a central theme within embodied perspectives.

Numerous studies have outlined the interplay between things such as bodily experiences and their roles within things such as attitudes, judgements and abstract thought. Although the present study has found limited evidence for the embodied effects within isolation, this does not exclude the possibility of cohesion effects between the embodied systems.

Research into embodied cognition perspectives has uncovered some very interesting phenomena. The impact of bodily responses is an area that features some of the most interesting in relation to the present study. The findings from studies such as Tom et al. (1991) where head nodding was seen to facilitate preference for a previously neutral objects, Priester et al. (1996) found isometric arm flexion, opposed to extension, could influence preferences for neutral non-words. Williams and Bargh (2008) found a link between the experience of temperature and interpersonal warmth, Jostmann et al. (2009) and Proffitt (2006) both found links between the bodily experiences of weight and its effect on judgements.

Sensorimotor experiences have also been seen to reveal the embodied nature of memory and comprehension as well as judgements (Ackerman et al., 2010). The work into the embodied nature of attitudes has also provided some interesting findings. Studies such as Schnall et al. (2008) found a link to cleanliness and moral purity and demonstrating that cleanliness can soften judgements about others. This link between cleanliness has been demonstrated multiple times, Zhong and Liljenquist (2006) found that soap and water can actually attenuate for an individuals moral transgressions. Lee and Schwartz (2010) also found that when participants committed an

action that they deemed to be unethical they were more likely to accept the offering of either a mouthwash or a hand sanitiser. Lending to the claim that the cleansing of the body in this instance also aides in the cleansing of the cognition.

Strack et al. (1988) found a link between facial expressions and the facilitation of either positive or negative attitudes in relation to the expression being either positive or negative. Chen and Bargh (1999) found that when presented with positive or negative valanced words, such as love or hate, participants made a response consistent with the feelings associated with the valance. For example, when presented with the word love participants would pull a lever rather than push it. Work conducted into the effect of body postures has also demonstrated the efficacy of an embodied perspective. Cuddy et al. (2012) demonstrated that high power poses facilitated performance within a job interview settings and also had an effect on hormone production. Demonstrating the relationship between preparatory nonverbal behaviour and subsequent performance (Cuddy et al., 2012).

The work into language comprehension within an embodied perspective is also of particular interest to the present study. Propositions such as the indexical hypothesis (Glenberg and Robertson, 1999,2000) and the immersed experience framework (Zwaan, 2004) aimed to provide theoretical accounts for future research to investigate and build upon. Work by Glenberg and Kaschak (2002) on their action-sentence compatibility effect provided an interesting insight into the possibility of language comprehension being grounded within bodily action. Zwaan and Yaxley's (2004) study also demonstrated the efficacy of adopting an embodied view of language comprehension as their study into spatial iconicity provided evidence for the utilisation of an embodied perspective.

Works by Munte et al. (1999) and Rinck and Bower (2000) have also demonstrated that violations of iconicity have an affect on on-line processing whilst utilising an inherently embodied approach their studies. Zwaan et al. (2002) utilised a sentence-picture mapping method, it was found that when the picture matched the shape that would have been mentioned in the sentence response rates were faster. The Stansfield and Zwaan (2001) study also found similar result, within their study participants read sentences describing an action that would results in an object having either a vertical or horizontal orientation and then judge if the pictured object was described. It was found that response times were faster when the orientations of the pictured object and the described object matched. The studies by Zwaan et al. (2002) and Stansfield and Zwaan (2001) demonstrated the possibility that individuals generate perceptual images of described scenarios in sentence comprehension (Weiskopf, 2010).

The literature mentioned thus far has noted some very interesting phenomena and provided some very convincing evidence that counts towards the plausibility and efficacy of utilising an embodied perspective when viewing cognition. When conducting the literature search the researcher noted a possible gap within present embodied research. It was noted that embodied studies so far have investigated many different areas and have looked at how different concepts could be grounded (Barsalou, 2008,2010; Jostmann, 2009; Proffitt, 2006). Or how different

approaches to studying the comprehension of language can facilitate different responses (Glenberg and Kaschak, 2002; Glenberg and Robertson, 1999,2000; Zwaan and Yaxley, 2004).

However what was noticed was that the current literature has not yet investigated the consequences of two embodied systems being activated and utilised at the same time. The researcher was unable to find a study that implicitly focussed on the outcome of multiple embodied systems being tested simultaneously.

This area is of particular interest when utilising an embodied approach, this is due to the nature of embodiment focussing on the interaction between the body, mind and environment (Clark, 1999; Barsalou, 1999,2008,2010; Anderson, 2005; Adams, 2010). If those are all elements of overall cognition and they all interact it may be possible that embodied systems such as bodily action and language comprehension could also interact. It could even be possible that dominance or cohesion effects could be evident. If both systems were activated at the same time it could be that one takes a dominant position and the other becomes subservient. Although no direct evidence has been found regarding the possibility of the cohesion or dominance effects mentioned. The body of evidence surrounding embodiment would suggest this effect could well be evident.

Utilising a combination of methodologies from experiments one and 2A, this experiment aims to investigate the possibility of the cohesion or dominance effects. Utilising directional hypotheses experiment 2B asserted that there would be significant interactions between the bodily effect of weight and spatial position of stimulus. It was asserted that the significant interaction would facilitate faster response times, lower amounts of errors and higher ratings respectively.

Method

Design

A 2x2x2 mixed design was utilised within experiment 2B. A within subject variable of word type was studied, with two levels of word or non-word. Two within subjects variables were studied. These were back pack, with two levels of backpack and no backpack, and position with two levels of top and bottom.

Participants

A total of 32 participants were sampled 12 were male and 20 were female. Variables such as age and ethnicity were not recorded or factored into the results. Participants were sampled via opportunity sampling and also contacted via email. Screening criteria remained the same within the experiment as was used in experiment one and two. Data from the 16 participants of experiment 2A was used in order to make a between subjects variable of the back pack condition.

Materials and Apparatus

The equipment used for presenting stimuli and recording responses from participants remained the same as used within experiment one and two.

Procedure

The procedure utilised within experiment 2B featured elements from both experiment one and two. Upon arrival at the location of the experiment participants were greeted by the researcher and asked the screening questions that were also asked within experiment one and two. Participants were then randomly allocated to either condition one or condition two.

Condition one featured participants undertaking the spatial lexical decision task whilst wearing a backpack, with condition two having participants undertake the spatial lexical decision task whilst not wearing a backpack. Participants were shown 120 trials on the lexical decision task and had to respond using keys on the keyboard. Pressing the Q key would register a “Word” response whilst pressing the P key would register a “Non-Word” response.

After the letter string appeared on screen a sentence appeared asking the participant to rate the letter string in terms of auditory pleasantness using a one to nine scale (1 =very poor, 9= very good) by pressing a number key on the keyboard. Upon completion of the task the participant was assisted with the removal of the backpack if in the relevant condition and thanked for participating. All participants were provided with a debrief form and informed that they could contact the researcher at any time if they had any questions or concerns.

Results

Hypothesis One

Descriptive analysis of the data indicated that participants were faster overall at reacting within condition two (see table five). This could indicate that the activation of multiple embodied systems provided a cohesion effect and facilitated faster response times. A 2x2x2 mixed ANOVA was conducted and found there to be a main effect of word type ($F(1,30)=21.728$, $MSE=199984.977$, $P<0.001$, $\eta2=0.420$). It was found that there was no main effect of position ($F(1,30)=0.177$, MSE-128620.207, $P=0.677$, $\eta2=0.006$) and no main effect of condition ($F(1,30)=2.387$, $MSE=3297293.66$, $P=0.133$, $\eta2=0.74$). The analysis did however find a significant interaction between position and word type ($F(1,30)=6.189$, $MSE=370271.743$, $P=0.019$, $\eta2=0.171$). No significant interactions were found for position and condition ($F(1,30)=0.393$, $MSE=128620.207$, $P=0.535$, $\eta2=0.13$) or word type and condition ($F(1,30)=1.798$, $MSE=199984.977$, $P=0.190$, $\eta2=0.57$). No significant interaction was found when looking at the interaction between position, word type and condition ($F(1,30)=1.362$, $MSE=1794911.06$, $p=0.252$, $\eta2=0.43$). Analysis of the data for reaction times found there to be no significant interaction between position and condition therefore the experimental hypothesis was rejected and the null hypothesis was retained.

Table Five: Mean and Standard Deviations of Reaction times (in ms) for experiment 2B

	Condition one: Back Pack		Condition two: No Back Pack	
	Top Position	**Bottom Position**	**Top Position**	**Bottom Position**
Word	2228.47 (SD 997.72)	2219.14 (SD 936.06)	1748.29 (SD 587.40)	1919.41 (SD 675.58)
Non-Word	2760.07 (SD 1291.24)	2636.53 (SD 1214.10)	2168.82 (SD 933.93)	2023.88 (SD 827.53)

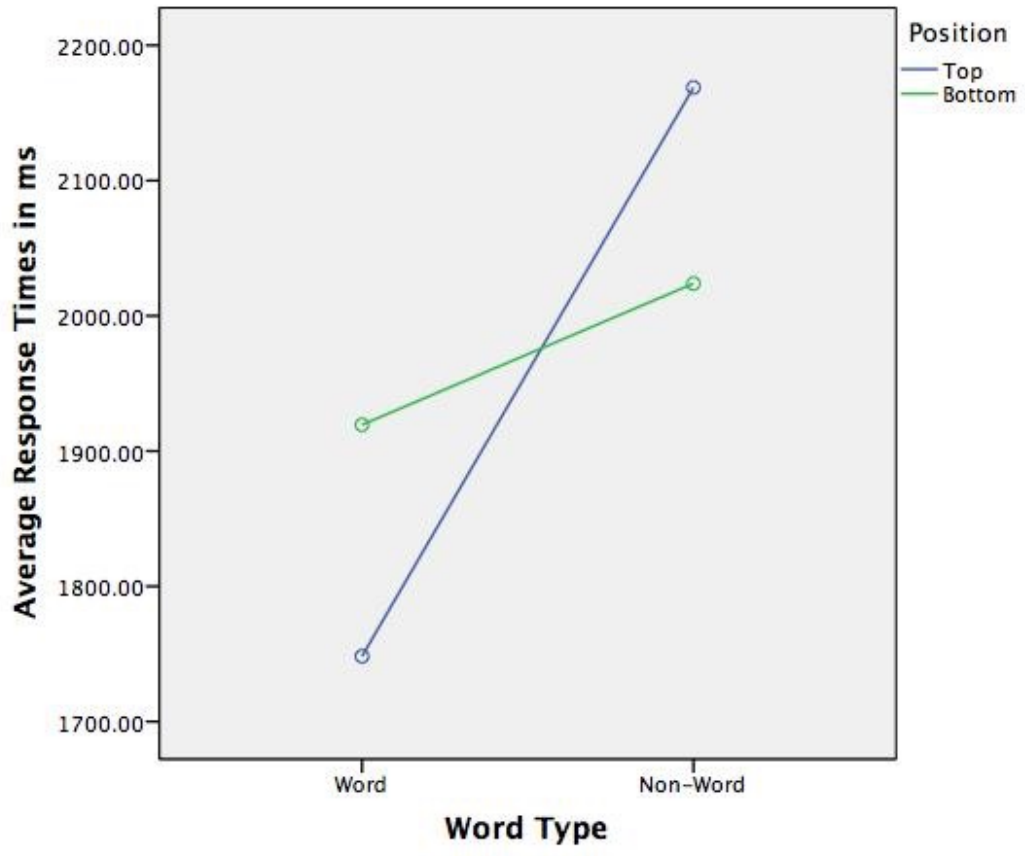

Figure Seven: ANOVA analysis of Reaction Times from condition one within experiment 2B

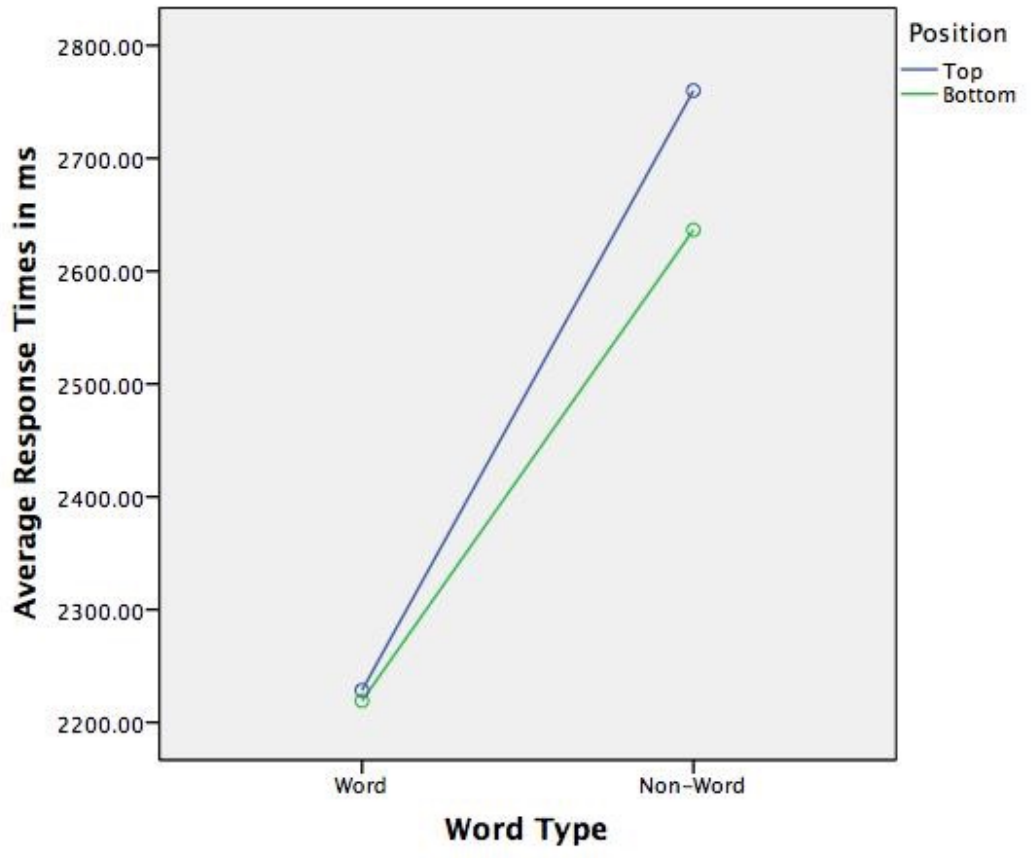

Figure Eight: ANOVA analysis of reaction times from condition two within experiment 2B

Hypothesis Two

Descriptive analysis of ratings within experiment 2B indicated that overall participants gave lower ratings within condition one (see table six). The lower ratings from condition one could be due to a load effect due to both the bodily action and language comprehension effects that were operating. A 2x2x2 mixed ANOVA was conducted and found there to be a main effect of condition ($F(1,30)=7.283$, $MSE=2.829$, $P=0.011$, $\eta2=0.195$) and also a main effect of word type ($F(1,30)=58.953$, $MSE=3.164$, $P<0.001$, $\eta2=0.663$). It was found that there was no main effect of position ($F(1,30)=0.011$, $MSE=0.116$, $P=0.919$, $\eta2<0.001$). The mixed ANOVA revealed that there were no significant interactions between position and condition ($F(1,30)=0.0299$, $MSE=0.116$, $P=0.589$, $\eta2=0.010$), word type and condition ($F(1,30)=3.556$, $MSE=3.164$, $P=0.069$, $\eta2=0.106$), position and word type ($F(1,30)=0.900$, $MSE=0.080$, $P=0.350$, $\eta2=0.029$) or position, word type and condition ($F(1,30)=2.815$, $MSE=0.080$, $P=0.104$, $\eta2=0.086$). Analysis of the data from ratings found there to be no significant interaction between position and condition. Therefore the experimental hypothesis was rejected and the null hypothesis retained.

Table Six: Means and Standard Deviations of Ratings for Experiment 2B

	Condition one: Back Pack		Condition two: No Back Pack	
	Top Position	**Bottom Position**	**Top Position**	**Bottom Position**
Word	5.87 (SD 0.68)	5.79 (SD 0.88)	7.15 (SD 1.55)	7.30 (SD 1.59)
Non-Word	4.27 (SD 1.49)	4.01 (SD 0.93)	4.01 (SD 0.98)	4.17 (SD 1.47)

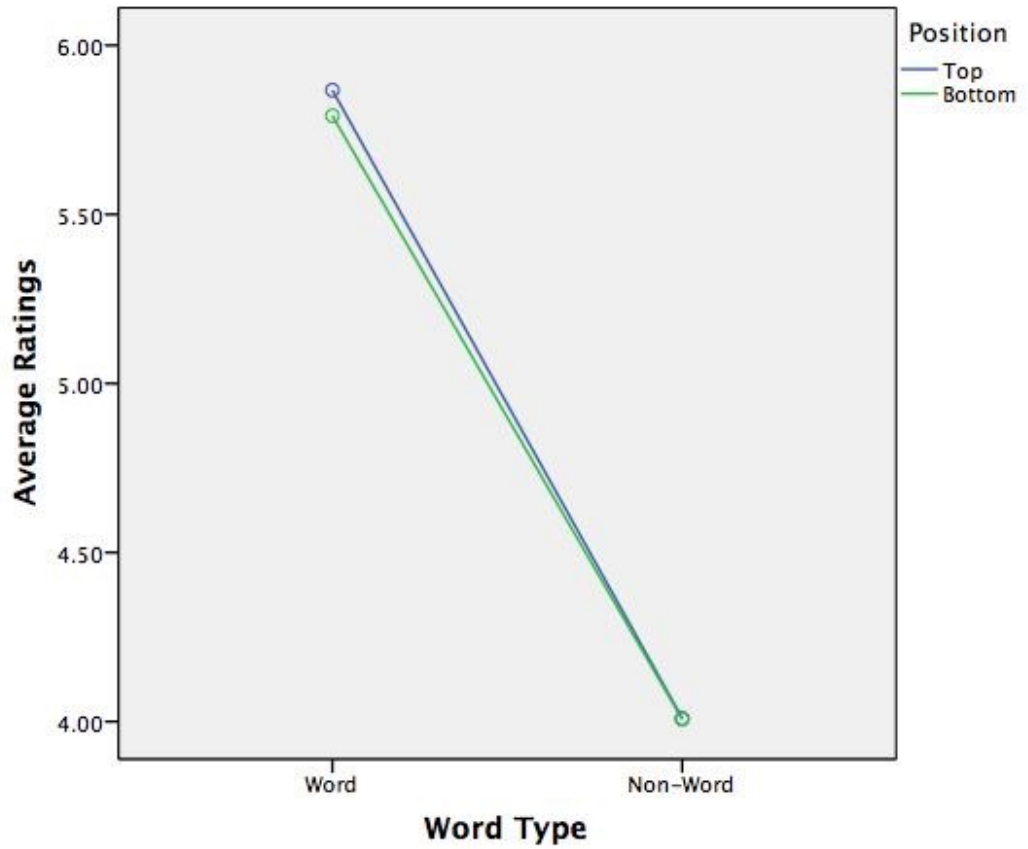

Figure Nine: ANOVA analysis of ratings from condition one within experiment 2B

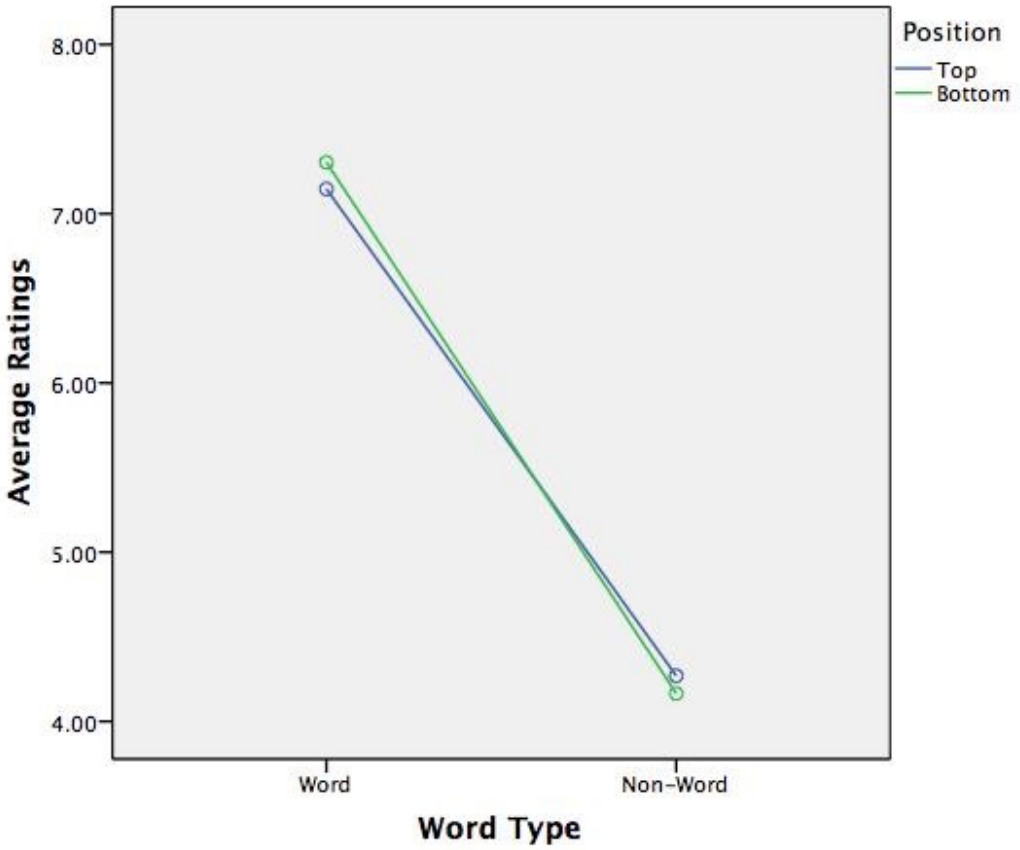

Figure 10: ANOVA analysis of ratings from condition two within experiment 2B

Hypothesis Three

Descriptive analysis of the error data within indicated that participants within condition two made more errors on average (see table seven). This could have been due to a lack of interaction between embodied systems so task performance wasn't facilitated to a level that would limit errors made. A 2x2x2 mixed ANOVA was conducted and found that there was no main effect of condition ($F(1,30)=0.575$, $MSE=20.683$, $P=0.454$, $\eta2=0.019$), position ($F(1,30)=0.006$, $MSE=1.333$, $P=0.939$, $\eta2<0.001$) or word type ($F(1,30)=2.568$, $MSE=23.022$, $P=0.119$, $\eta2=0.079$). The mixed ANOVA also reported that there were no significant interactions between position and condition ($F(1,30)=1.319$, $MSE=1.333$, $P=0.260$, $\eta2=0.042$), word type and condition ($F(1,30)=0.953$, $MSE=23.022$, $P=0.337$, $\eta2=0.079$), position and word type ($F(1,30)=0.683$, $MSE=1.385$, $P=0.415$, $\eta2=0.022$) or position, word type and condition ($F(1,30)=1.630$, $MSE=1.385$, $P=0.211$, $\eta2=0.052$). As the analysis of the error data showed that there was no significant interaction between position, and condition the experimental hypothesis was rejected and the null hypothesis retained.

Table Seven: Means and Standard Deviations for Amount of Errors made on the Spatial Lexical Decision Task within Experiment 2B

	Condition one: Back Pack		Condition two: No Back Pack	
	Top Position	**Bottom Position**	**Top Position**	**Bottom Position**
Word	1.31 (SD 1.58)	1.44 (SD 1.21)	1.06 (SD 1.29)	1.25 (SD 1.81)
Non-Word	1.75 (SD 1.84)	2.06 (SD 2.43)	3.69 (SD 6.68)	3.00 (SD 5.48)

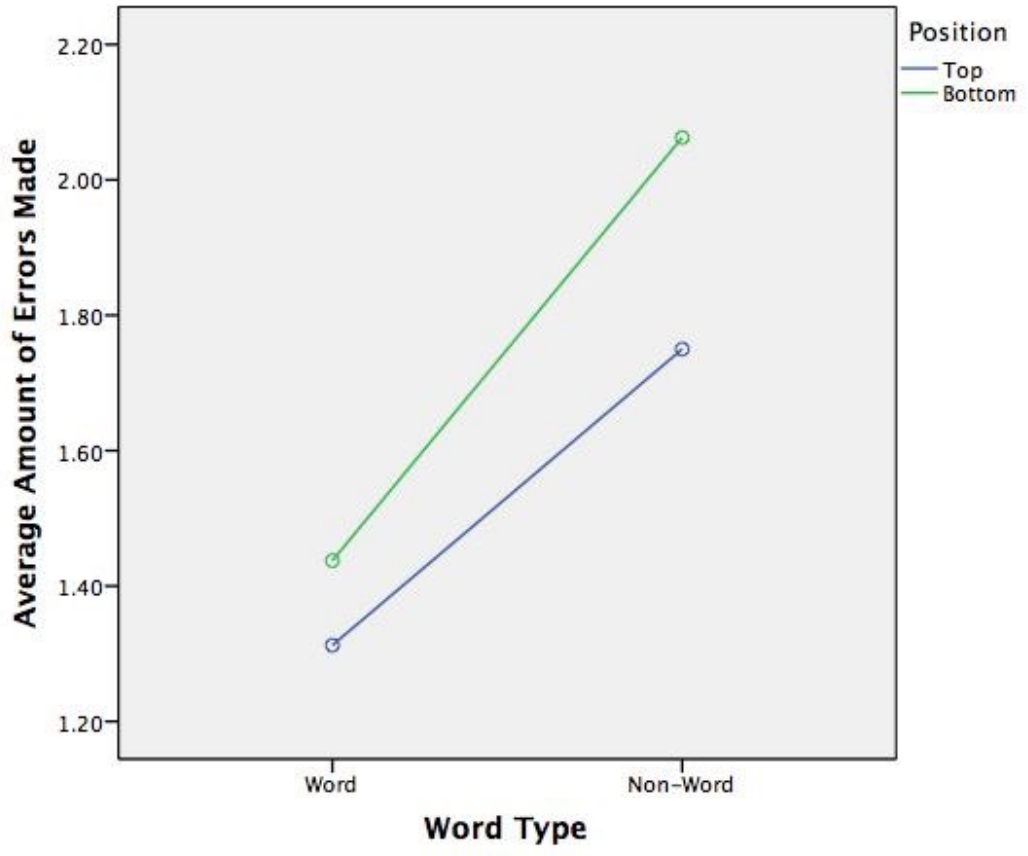

Figure 11: ANOVA analysis of average amount of errors made within condition one in experiment 2B

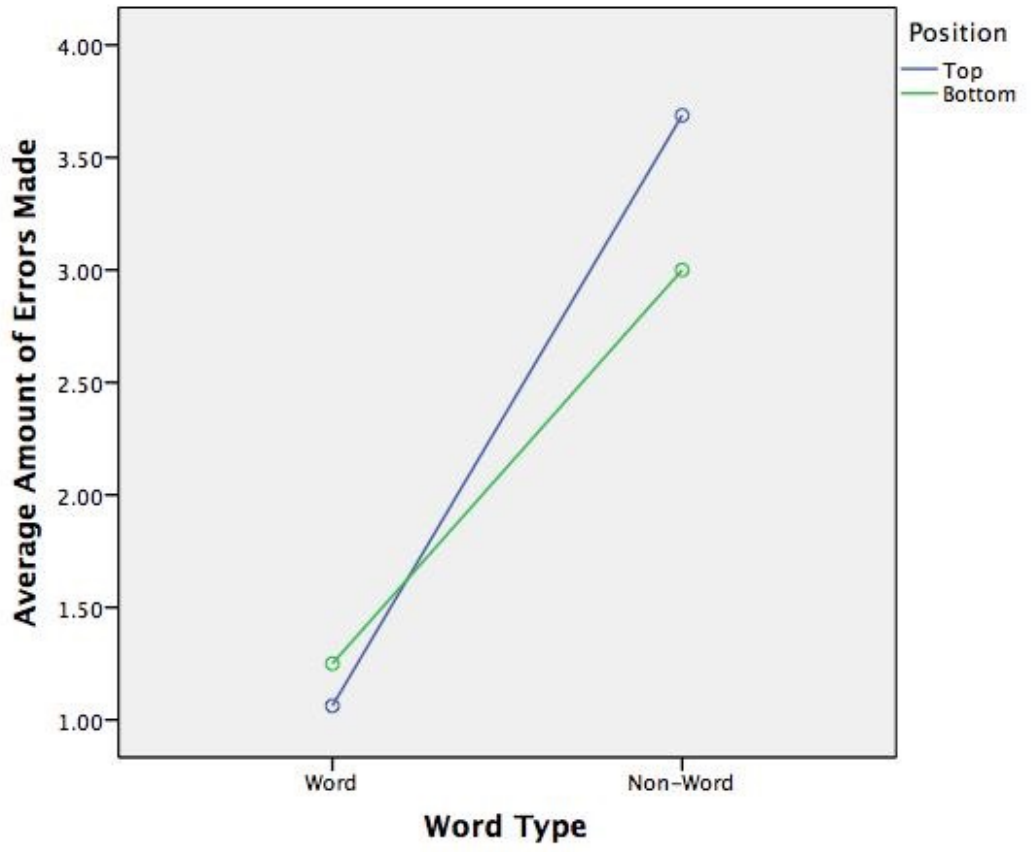

Figure 12: ANOVA analysis of average amount of errors made within condition two in experiment 2B

Experiment 2B Discussion

Analysis of hypothesis one found that the experimental hypothesis was rejected due to a lack of a significant interaction between position and condition. The lack of any main effects could potentially display the possibility of absence of any embodied system being evident. This could lead to the notion of embodiment not being an effective perspective when viewing cognition. Although, there was a significant interaction found between word type and position, this would support past work from Glenberg and Kaschak (2002).

The findings from hypothesis one would not directly support theories of embodiment (Clark, 1999; Barsalou, 1999,2008,2010; Anderson, 2005; Adams, 2010), or past research (Proffitt, 2006; Jostmann et al., 2009). This is due to the lack of main effects found within the analysis, the lack of a main effect of condition would contradict the findings from Proffitt (2006) and Jostmann et al. (2009) due to the differences in condition being the weight experienced.

Analysis of hypothesis two found that there was no significant interaction between position and condition. This led to the experimental hypothesis being rejected and the null hypothesis retained. This would therefore indicate that the effects of any of the variable factors are not dependent on any of the others. This finding could also indicate that there was no dominance

effect evident and that it could be that there was a cohesion effect between the systems that facilitated task performance.

The finding of a main effect of condition is consistent with theories of embodiment (Clark, 1999; Barsalou, 2008,2010; Anderson, 2005; Adams, 2010) and also with past research (Proffitt, 2006; Jostmann et al., 2009) as the findings show an effect of weight on judgements. The finding of a main effect of word type also provides empirical support for work into language comprehension and it's embodied nature (Glenberg and Kaschak, 2002; Glenberg and Robertson, 2000).

Analysis of hypothesis three found that there were no main effects of any of the variable factors within the experiment. This would indicate a lack of support of embodied perspectives (Clark, 1999; Barsalou, 1999,2008,2010; Anderson, 2005; Adams, 2010) and also past research (Proffitt, 2006; Jostmann et al., 2009; Glenberg and Kaschak, 2002; Glenberg and Robertson, 2000). The lack of significant interaction effects lead to the conclusion that there were no dominance effects evident, leading to the indication that a cohesion effect was evident that facilitated task performance. This becomes more credible when looking at the means and standard deviations (see table seven) as condition one displayed lower overall values. Indicating the possibility of the activation of multiple embodied systems creates a cohesion effect rather than a dominance effect.

Within experiment 2B there could be some methodological issues. Sampling issues could be a factor in the lack of main effects and significant interactions found. A sample size of 32 was used for this experiment which is lower than used within past research (Proffitt, 2006; Jostmann et al., 2009; Glenberg and Kaschak, 2002). This sample size effect could be easily rectified within future research. As noted earlier this area of research is one that is lacking within the embodied literature that is available. Future research is needed to investigate the possibility of dominance or cohesion effects if the notion of cognition being embodied is to be fully understood. More research is needed within this area to fully understand if any effects are truly evident.

General Discussion

The present study operated within the realms of an embodied perspective incorporating accounts of embodiment from such authors as Clark (1999) and Barsalou (1999,2008,2010). As noted earlier work within this embodied perspective has produced some very interesting findings which in turn provided more theorists and researchers with new knowledge and new research opportunities. It is important however to ensure a critical evaluation is undertaken of this embodied perspective to ensure it's efficacy is at a level that is suitable and acceptable enough to be considered a mainstream approach to cognition.

First let us look at embodiment from a scientific point of view. When considering a theory from a scientific point of view one element that is said to be of importance is that of falsifiability (Popper, 1963). It was argued that the differences of theories such as Freudian psychoanalysis and Newtonian physics comes from their ability to be disproved. For a theory to be falsifiable it is required that there is a possibility that evidence could be provided that would be able to disprove the theory, not just to support it (Livins and Doumas, 2012).

This element of falsifiability becomes much more important when competing theories exist within the same domain. When looking at an area such as embodiment it is clear that this element of falsifiability is one that is essential. For an embodied theory to be deemed properly credible within a scientific psychological domain it must surely meet this need of falsifiability. There are clearly a number of different theoretical approaches when looking at embodied theories of cognition. Wilson (2002) noted six there are also perspectives put forward by Barsalou (1999,2008), Anderson (2003), Ziemkie (2003), Clark (1999) and still more.

Although this abundance of theorising about one particular area can be viewed as beneficial, due to the amount of interest and research that is generated, it can also be seen as a hindrance in regard to evaluating the falsifiability of such theories (Livins and Doumas, 2012). Within their review of embodied theories and their claims in relation to falsifiability, Livins and Doumas (2012) argued that they all lacked the ability to fill out the statement of “theory x would be untrue if y were to happen” via means of measurable or definitive claims. When theories are based on foundations that can be deemed unclear it is problematic, Newell (1973) also argued that cognitive science can often be guilty of discovering something, conducting experiments on that area and then never adequately considering what the research means. Moving forward embodied research must devote attention to combatting this area of falsifiability if it is to establish itself as a dominant theory within cognitive psychology. For embodied cognition to be truly radical as claimed by Clark (1999) this is an issue that needs dealing with.

Within embodied cognition it appears that there are two main strands that are utilised by both theorists and researchers. Clark (1999) distinguished those two strands as simple and radical embodiment, citing that the latter was the more prominent and garnered more attention. The acceptance of the radical approach to embodiment would be the dismissal of more traditional approaches and their frameworks. Acceptance of the simple embodiment approach would mean retaining frameworks set by traditional theories but also factoring in some embodied elements.

Considering the literature that has been cited within the present study regarding embodiment, it is important to ensure that the findings from such studies could not be explained by more traditional disembodied approaches. The action-sentence compatibility effect proposed by Glenberg and Kaschak (2002) is one such approach that could possibly be explained via utilisation of a more traditional approach. Weiskopf (2010) argued that the common coding approach utilised within this embodied approach was difficult to distinguish from a disembodied amodal account.

Weisskopf noted that as shared representational codes have the ability to explain the facilitation or inhibition effects, the use of the amodal account has the same structure as the embodied account. It was also argued that both traditional and embodied accounts could provide

an explanation of the action compatibility effect as the evidence did not provide sufficient differences between them for one to become more prominent than the other. However this does not completely discredit the utilisation of the embodied approach in this instance as Weiskopf (2010) noted that both accounts are loosely organised with numbers of models that share core principles. Weiskopf (2010) concluded by claiming that the traditional view of language had the means to provide explanations that combatted the criticisms raised by the elements of embodied cognition. However it was noted that it would not be wise to completely dismiss the influence of perception and action within the facilitation of cognition.

The interest in bodily action in regard to embodiment is one that has been studied at depth (Priester et al., 1996; Petterson, 1991; Petty et al,. 1995; Proffitt, 2006; Jostmann et al., 2009; Cuddy et al., 2012). Results from the studies have provided compelling evidence for the involvement of bodily action in the facilitation of cognition. Recent work within the field of cognitive neuroscience has found that the brain region that control actions are involved when a response is made to action related language (Willems and Hagoort, 2007). Such studies would be of use to assess in some clarity the profundity of the effect of bodily action in regards to cognition.

Studies have also shown that sensorimotor regions are somatotopically activated during the processing of action related language (Hauk et al., 2004; Esopenko et al., 2008; Raposo et al., 2009). It could be seen therefore that the use of these neuroimaging techniques provides a form of evidence that puts to rest the issue of falsifiability that was mentioned earlier. The use of such techniques provides a view of the activated brain regions and shows a justifiable link between embodiment and cognition.

However, Esopenko et al. (2012) noted that although the motor system has been seen to be activated during semantic analysis it is just a byproduct of that process and that the motor system is not actually needed for semantic processing (Mahon and Caramazza, 2005,2008). Evidence in favour of the disembodied view found that apraxia patients that were impaired when using objects but could still name the use of associated objects (Negri et al., 2007). Mahon and Caramazza (2008) also argued that the conclusions drawn from the research in to sensory and motor systems regarding embodiment do not follow the empirical evidence. They also claimed that the embodied cognition hypothesis could not be “true as a general theory of human cognition.” Although these claims do seem to have some grounding, especially in the cases of the apraxia patients.

It could be argued that as such evidence has not discounted the role of bodily action, studies such as those by Proffitt (2006) and Jostmann et al. (2009) propose the possibility still remains that the effect of bodily action is compelling. It could be argued that the Cuddy et al. (2012) study displayed some compelling evidence of the efficacy of bodily action. The power poses adopted by the participants were seen to cause a change in hormonal balance, testosterone was boosted and cortisol was lowered, this highlights a link between bodily action and cognition. This is seen when looking at how high testosterone is associated with increased performance in tasks and increased presentation quality (Carney et al., 2010; Mehta and Josephs, 2010). This physiological

data provided by the Cuddy et al. (2012) study can again be seen to challenge the problem of falsifiability that was raised earlier.

Within the first two experiments of the present study it was found that the clear embodied phenomena found within previous studies (Proffitt, 2006; Jostmann et al., 2009) were not as evident as would first be believed. Although experiment one and 2A found that there were some main effects and some significant interactions between variable factors, these did not indicate the clear embodiment found within the previous studies. The researcher did however note that this could have been down to methodological issues that would need addressing with further research.

The results from experiment 2B demonstrated the possibility of a cohesion effect between embodied systems. This cohesion effect could most easily be seen when looking at mean values from reaction times, ratings and amount of errors made. For each hypothesis results within condition one conformed to this claim, reaction times were faster, ratings were more positive and the amount of errors were lower within the condition where two embodied systems were being utilised. The ANOVA analysis also provided some more statistical evidence for this. It is important now that future research provides some focus on this area to allow for the fully understanding of how this cohesion effect works.

This paper aimed to present the embodied cognition hypothesis and provide evidence of the efficacy and plausibility of adopting such a view of cognition. The paper also aimed to assess a gap in the current research and explore the notion of dominance effects within the activation of embodied systems. Through exploration of experimental hypotheses a novel study was undertaken and new knowledge was added to the field. It is hoped that the findings of this study will facilitate the undertaking of more research in to the area to provide even more knowledge to an ever expanding area of cognitive psychology.

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Appendix

Appendix A:

Email to participants

Hello,

My name is Lee Priest and i am currently a Master of Research (MRes) Psychology student. I am undertaking a research and require your participation if possible.

I would like to ask for around 10 minutes of your time to help me with my research project. Your participation in this research project will involve you undertaking a lexical decision task. This task involves you looking at a letter string and making a response as to if the word is either a word or a non-word and also a response as to your feelings toward that string.

Further information about this research project can be provided to you if you are unsure. If you are interested in this study and are willing to donate some of your time to take part, please send a reply to my university email address at u1055969@hud.ac.uk

Remember that participation is entirely voluntary and that any and all data collected will be anonymous and confidential.

The study will be taking place in the Ramsden building in room R208 on the 10th, 11th and 12th of June between 12pm and 4pm each day.

Thank you for your help.

Lee Priest

Appendix B:

Words Utilised Within the Lexical Decision Tasks

Words

1. animal
2. apple

3. art
4. astronaut
5. ancestor
6. atlas
7. avenue
8. awaken
9. badge
10. bake
11. balcony
12. basketball
13. bell
14. bland
15. brick
16. bus
17. cane
18. cast
19. class
20. clause
21. cling
22. cognition
23. concentrate
24. cope
25. counselor
26. crab
27. critique
28. derelict
29. distracted
30. erase
31. excuse
32. fender
33. fingerprint
34. fur

35. gloat
36. govern
37. incubator
38. insect
39. kidney
40. label
41. lease
42. listless
43. marrow
44. motel
45. nonsense
46. obey
47. packet
48. peep
49. plain
50. policy
51. revert
52. shadow
53. skeptical
54. wall
55. windshield
56. toad
57. therapy
58. subdue
59. stupor
60. smudge

Non-Words

1. ainmal (animal)
2. alepp (apple)
3. rta (art)
4. atrsnoatu (astronaut)

5. acenstro (ancestor)
6. altsa (atlas)
7. aenveu (avenue)
8. akwaen (awaken)
9. bedga (badge)
10. bkae (bake)
11. blonacy (balcony)
12. basktelbal (basketball)
13. blel (bell)
14. balnd (bland)
15. birkc (brick)
16. bsu (bus)
17. cnae (cane)
18. csat (cast)
19. calss (class)
20. caules (clause)
21. cilng (cling)
22. cigontion (cognition)
23. coencntrate (concentrate)
24. coep (cope)
25. cuonsloer (counselor)
26. cbar (crab)
27. cirituqe (critique)
28. dreeilct (derelict)
29. dstiarcted (distracted)
30. earse (erase)
31. ecxsue (excuse)
32. feendr (fender)
33. figernripnt (fingerprint)
34. fru (fur)
35. goalt (gloat)
36. groven (govern)

37. inucabtor (incubator)
38. inesct (insect)
39. keindy (kidney)
40. lebal (label)
41. laese (lease)
42. lestsits (listless)
43. moarrw (marrow)
44. moetl (motel)
45. nosennse (nonsense)
46. oeby (obey)
47. peckat (packet)
48. eppe (peep)
49. palin (plain)
50. picoly (policy)
51. reevrt (revert)
52. shaodw (shadow)
53. skipetcal (skeptical)
54. wlal (wall)
55. wiindeshld (windshield)
56. taod (toad)
57. theapry (therapy)
58. suudbue (subdue)
59. sutpor (stupor)
60. sumgde (smudge)

Appendix C:

Participant Information Sheet

You are being invited to take part in this study that is exploring responses to the presentation of different words. Before you decide to take part it is important that you fully understand why the

research is being conducted and what it hopes to achieve. Please ensure that you read the following information carefully and discuss it with the researcher if you wish. Please feel free to ask any questions if there is anything you are unsure of throughout any part of this study.

What is the study about?
The purpose of this study is to investigate how responses to words presented to people can differ.

Why I have been approached?
You have been approached because the researcher thought you would be suitable for participation in the research and that you would provide data and results that would be inline with the research.

Do I have to take part?
This is completely your decision. You are under no obligation to take part and do so completely at your own wish. Please be aware that you have the right to withdraw at any point if you so wish without having to provide a reason or justify anything to the researcher. If you do decide to take part you will be asked to sign a consent form so there is a record of your consent to be a part of the study, this does not affect your right to withdraw. If you complete part of the study and decide to withdraw any data gathered will be omitted from the study and destroyed.

What will I need to do?
If you agree to take part in this study you will be required to take part in a lexical decision task. This task will involve you reading words on a screen and making a response using a response pad that is provided to you. You may be allocated to a condition in which you will be required to wear a weighted backpack, this backpack will contain 5kg of weight. The study should last around 10 minutes and will be recorded using a PC that will be running windows 7 and using Superlab software for the lexical decision task.

Will my identity be disclosed?
Any and all information disclosed by you at any point during the study will be kept confidential, unless a legal situation arises that would require the researcher to disclose information to appropriate personnel.

What will happen to the information?
Any and all information collected from you during this research study will be stored securely on a password protected computer, information that could identify you as an individual will be removed to ensure anonymity.

Who can I contact for further information?
If you require any further information about the research, please contact me on:

Name: Lee Priest

E-mail: u1055969@hud.ac.uk

Appendix D

CONSENT FORM

It is important that you read, understand and sign the consent form. Your contribution to this research is entirely voluntary and you are not obliged in any way to participate, if you require any further details please contact your researcher.

I have been fully informed of the nature and aims of this research ☐

I consent to taking part in it ☐

I understand that I have the right to withdraw from the research at any time ☐ without giving any reason

I give permission for my words to be quoted (by use of pseudonym) ☐

I understand that the information collected will be kept in secure conditions ☐ for a period of five years at the University of Huddersfield

I understand that no person other than the researcher/s and facilitator/s will ☐ have access to the information provided.

I understand that my identity will be protected by the use of pseudonym in the ☐ report and that no written information that could lead to my being identified will be included in any report.

If you are satisfied that you understand the information and are happy to take part in this project please put a tick in the box aligned to each sentence and print and sign below.

Signature of Participant:	Signature of Researcher:
Print:	Print:
Date:	Date:

(one copy to be retained by Participant / one copy to be retained by Researcher)

Appendix E

Debriefing Sheet

This study was investigating an area within psychology called Embodied cognition. This area is concerned with the combination of the mind and body as both facilitating cognition, rather than the mind body separation upheld in traditional cognitive psychology literature. This study was concerned with measuring your response to words presented and how their position on the screen

could affect your ratings of them. The use of a back pack in select conditions also aimed to uncover any affect on word ratings and response times. The main aim of the study was to investigate the possibility of a dominant embodied system, the two systems this study investigated were the linguistic and bodily state systems.

How was this tested?
This study consisted of three conditions. The participants allocated to condition one performed a lexical decision task with words being presented at different heights, participants did this while standing. Within condition two participants performed a lexical decision task with a weighted backpack on their back with a weight of 10kg, this lexical decision task had words at a static central level. Condition three had participants perform a lexical decision task with words at differing heights also whilst wearing the weighted backpack.

The reasons for the conditions being set out like this was so data could be collected and analysed to see if any possible dominance effect from certain embodied cognitive systems (i.e linguistic or bodily state) were evident.

The lexical decision task was used as it allows for measures such as response times and ratings to be gathered on words seen. Past research in to embodied cognition has found that differences in word position can effect judgements on the words that are presented, words higher up gained a more positive response than those words presented lower down. The lexical decision task with words at different heights allowed the researcher to measure this possible effect. Weight has also been used in past research and has been found to also have an effect on judgements, heavier weight has been found to produce judgements of a more serious nature than that of lighter weight. By combining the lexical decision task and these two stimuli, it made it possible to uncover any possible dominance effect of either the linguistic or bodily state systems.

What data were collected?
The data that was collected during this study were your response times to the words presented and also your ratings of the words. All data is completely anonymous and will be destroyed after five years.

Researcher contact details
If you have any concerns or queries or if you wish to know more about this research study or embodied cognition as a whole feel free to contact the following individuals:

Lee Priest
Email Address: U1055969@hud.ac.uk

Dr David Peebles
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Dr Pelham Carter
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