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The Impact of Connectivity and Through-Movement within Residential Developments on Levels of Crime and Anti-Social Behaviour

Dr. Rachel Armitage



The project

This briefing note focuses upon the impact of levels of connectivity and through-movement (within residential housing developments) on levels of crime and anti-social behaviour (ASB). The note is one of a series of themed papers which reports the findings from a collaborative project funded by the Home Office and managed by the Commission for Architecture and the Built Environment (CABE). The project set out to strengthen and update the evidence base on the impact of residential design on a range of crime types – with a specific focus on housing developments acclaimed for their innovative design and award winning architecture. It should be highlighted that although this briefing note is designed as a summary document, the findings and recommendations are based upon a seven month project conducted by a consortium of universities including experts within the field of designing out crime, statistical modelling, urban design and Geographical Information Systems (GIS). The project was overseen by an expert Steering Group who ensured that the research was conducted to the required standards in terms of independence and methodological rigour.

The main aim of the research was to establish which features of residential design impact upon crime (either positively or negatively) and whether these design features are those being promoted as good practice within planning policy and guidance. In terms of connectivity and through-movement, this includes questions such as:

- Are culs-de-sac safer than through roads?
- Are some cul-de-sac designs safer than others?
- Can footpaths be included within a development without increasing crime risks?
- How safe are gated developments?

Recent and imminent changes in both planning policy and policing provision, increase the importance of ensuring that research findings are conveyed in a clear and comprehensible format. Practitioners (with increased workloads and reduced numbers) and newly formed community and locally based bodies need to be able to extract the relevant implications and apply these to proposed developments within their area. For this reason, this series of briefing notes will not dwell on the complex research methodology or detailed analysis; rather it will focus upon the key recommendations for policy and practice.

The methodology

A brief overview of the sample and methodology is required to allow the reader to place the findings in context. The diagram below displays the three strands which formed the basis of the research. The first involved scoping the evidence (a literature and policy review), to establish what previous research had been published relating to the impact of residential design on crime, and whether findings were consistent or contradictory. The second strand (Macro Level) involved investigating whether there is a link between housing design quality (as judged by CABE's Housing Audits) and crime. The third strand (Micro Level) aimed to look in detail at the link between specific design features of residential housing and crime.

As the diagram reveals, the sample included:

- Scoping the Evidence - 74 policy, guidance and research documents.
- Macro Level – 34 developments (including 4091 properties) from the three police forces Greater Manchester, West Midlands and Kent.
- Micro Level – 12 developments (2193 properties) from the three police forces Greater Manchester, West Midlands and Kent.

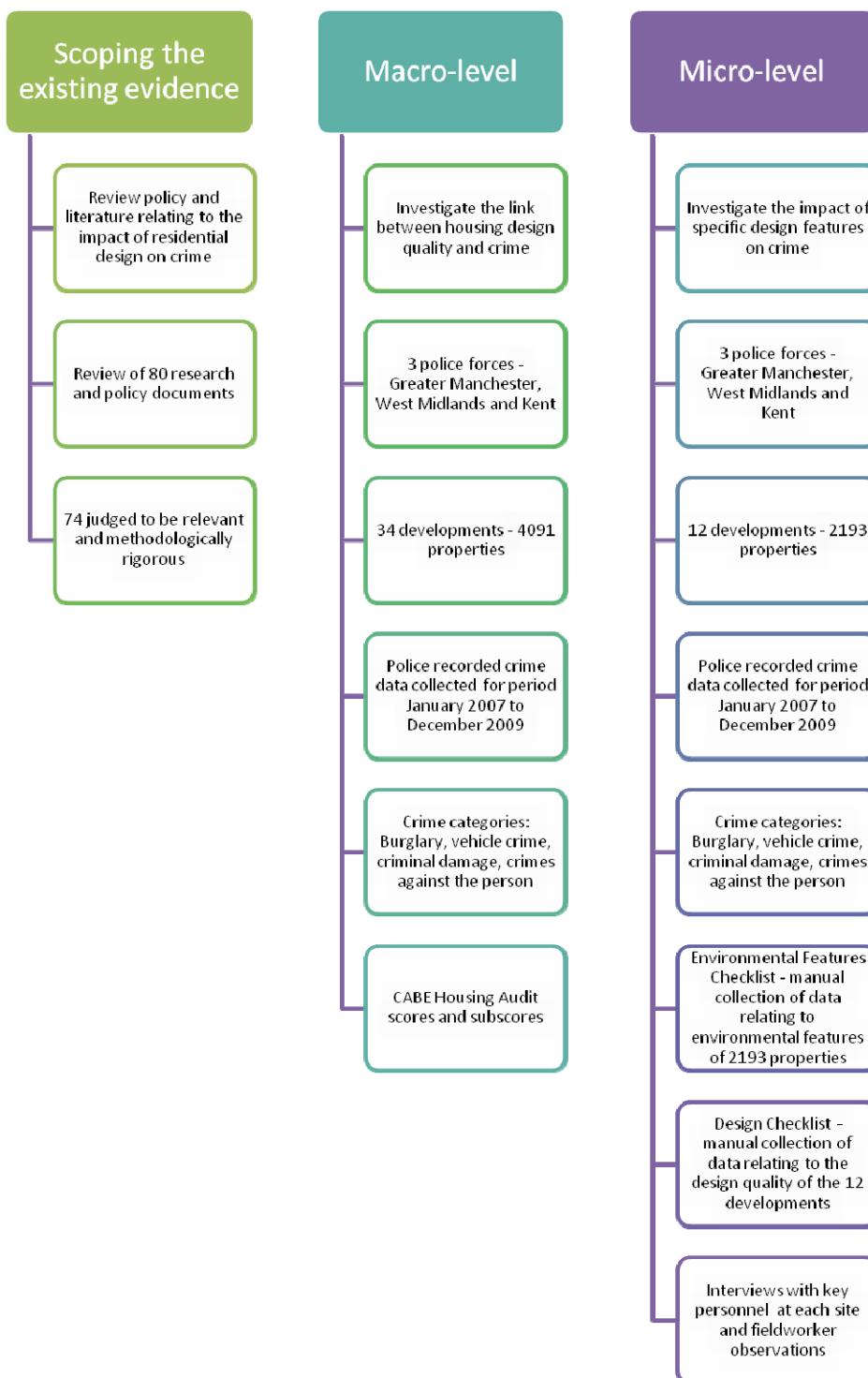


CABE is now part of the Design Council



Police recorded crime data were collected (at property level) for the three year period January 2007 to December 2009 for the crime types burglary, vehicle crime, criminal damage and crimes against the person. For the Macro Level, crime data were supplemented by CABE Housing Audit scores and sub-scores relating to the design quality of the 34 developments. For the Micro Level, crime data were supplemented by the following additional data:

- Interviews with key personnel – including the police Architectural Liaison Officer/Crime Prevention Design Advisor (ALO/CPDA), the Local Authority Planning Officer, the local Neighbourhood Policing Team and, in some cases, a representative from the local Residents' Association.
- Environmental Features Checklist - data relating to 31 specific design features of the 2193 properties, with a further 19 questions related to the development on which they were located.
- Design Checklist – data relating to the design quality of each of the 2193 properties (and the developments on which they were located).



The findings

Review of literature and policy

Debates surrounding connectivity and through-movement (often referred to as permeability) dominate the academic and policy literature on designing out crime within residential housing. Often findings have been overstated as a means of creating headlines such as “End of the Road for the Cul-de-Sac” (Fairs, 1998, p.1), “Culs-de-Sac Hit the Skids” (Stungo, 1998, p.2) and “How Brookside Boom Helped the Burglars” (Summerskill, 2000, p.16). However, such simplification has proved unhelpful for many crime reduction practitioners who are tasked with reducing crime through the design and manipulation of the environment.

A review of relevant research suggests that the cul-de-sac layout is favoured by the majority of criminological literature. However, urban designers highlight the negative features of this low permeability layout (including the increase in travel distances and therefore reliance upon the motor vehicle). Explanations for higher crime in areas of greater connectivity point to the operation of three underlying mechanisms. Firstly, developments with high levels of through-movement provide ease of entry and escape for potential offenders (Rubenstein et al, 1980; Taylor and Gottfredson, 1987; Poyner and Webb, 1991). Secondly, developments with high levels of through-movement are more likely to fall within the activity space, and therefore awareness space, of potential offenders (Brantingham and Brantingham, 1984) with offenders selecting targets as they take part in day to day activities (Letkemann, 1973; Feeney, 1986; Gabor et al, 1987; Poyner and Webb, 1991; Rengert and Wasilchick, 2000; Wiles and Costello 2000). The third mechanism suggests that developments with high levels of through-movement offer increased levels of anonymity for potential offenders (Angel, 1968; Suttles, 1968; Brantingham and Brantingham, 1975; Taylor and Gottfredson, 1987; Poyner and Webb, 1991).

Although Hillier and Sahbaz (2009) have argued that there are insufficient empirical studies to form any conclusions regarding the impact of road layout on residential crime, the review of literature would suggest otherwise. A range of studies conducted across Europe and North America have demonstrated the link between high connectivity/through-movement and crime by employing a range of methodologies and varied indicators of connectivity. Beavon et al (1994, in Canada) and Johnson and Bowers (2010, in the UK) demonstrated that increases in the number of roads connected to a street segment led to statistically significant increases in the number of burglaries to that segment. These increases were greatest when street segment connections led to a major traffic thoroughfare (White 1990, in the USA and Johnson and Bowers 2010). Further, the majority of research projects directly comparing burglary levels on highly connected through roads to culs-de-sac and streets with the lowest connectivity have demonstrated that culs-de-sac experience the lowest rates of burglary (Bevis and Nutter, 1977; Mirlees-Black et al, 1998; Rengert and Hakim, 1998; Armitage, 2000; Hakim et al, 2001; Yang, 2006; Johnson and Bowers, 2010). Johnson and Bowers’ (2010) study further concluded that culs-de-sac are safer than through roads and that sinuous culs-de-sac are safer still. However the study did not distinguish between ‘true’ culs-de-sac and ‘leaky’ culs-de-sac (those that are breached by footpaths). Research has demonstrated that leaky culs-de-sac experience more crime than true culs-de-sac and through roads (Armitage, 2006; Hillier, 2004). Therefore, any research that conflates leaky and true culs-de-sac is liable to dilute positive conclusions relating to culs-de-sac.

Taylor (2002) concluded that: “Neighbourhood permeability is ... one of the community level design features most reliably linked to crime rates, and the connections operate consistently in the same direction across studies: more permeability, more crime” (Taylor, 2002: 419). However, a prominent exception to this assertion relates to studies conducted using Space Syntax techniques which have concluded that increased levels of through-movement have a beneficial impact upon crime (Rudlin and Falk, 1995; Jones and Fanek, 1997; Hillier and Shu, 1998, 2000; Shu, 2000; Shu and Huang, 2003; Hillier, 2004; Hillier and Sahbaz, 2009). Only one study utilising Space Syntax measures has found high local integration and high connectivity to be positively associated with crime, including breaking and entering, larceny, vehicle theft and robbery (Nubani and Wineman, 2005). Using Space Syntax, Hillier and Sahbaz (2009) argue that high levels of street connectivity in a grid-like system result in lower levels of crime, with lower levels of connectedness resulting in higher vulnerability to crime. Hillier and Sahbaz (2009) argue that culs-de-sac are the least safe option but can be safer where they are embedded into the street network and made large and linear enough to provide that safety in numbers. The divergence between findings stemming from the use of Space Syntax and those from other approaches appears to be the product of key differences in methodology. Although Space Syntax allows for greater sample sizes (Hillier and Sahbaz looked at 101,849 properties) the methodology relies on the remote and automated assessment of street layouts and movement patterns which may not reflect the true nature of street layouts and how they are used. Studies that have manually assessed the area (or asked offenders to comment on vulnerability whilst at the development) have all concluded that increased connectivity and through-movement leads to increases in crime. The table below summarises the literature reviewed on the impact of through-movement on levels of crime within residential developments, highlighting the dominance of studies concluding that higher levels of through-movement increase the risk of crime.

Summary of existing literature

Study revealed that:	Study reference
Being located on a development with high levels of permeability/connectivity/through-movement <u>increases</u> the risk of crime	Bevis and Nutter (1977) Rubenstein et al (1980) Taylor and Gottfredson (1987) Van der Voordt and Van Wegen (1990) White (1990) Poyner and Webb (1991) Beavon et al (1994) Mirlees-Black et al (1998) Rengert and Hakim (1998) Hakim et al (2001) Taylor (2002) Nubani and Wineman (2005) Yang (2006) Armitage (2006)
Being located on a travel path <u>increases</u> the risk of crime	Letkemann (1973) Brantingham and Brantingham (1984) Feeney (1986) Gabor et al (1987) Poyner and Webb (1991) Wiles and Costello (2000) Rengert and Wasilchick (2000)
Being located on a culs-de-sac, or a development with low connectivity, <u>reduces</u> the risk of crime	Bevis and Nutter (1977) Johnson and Bowers (2010)
Closing off streets <u>reduces</u> crime	Matthews (1992) Atlas and LeBlanc (1994) Newman (1995,1996) Lasley (1998) Zavoski et al (1999) Eck (2002)
Being located on a leaky culs-de-ac <u>increases</u> the risk of crime	Hillier (2004) Armitage (2006)
Being located on a development with high levels of permeability/connectivity/through-movement <u>reduces</u> the risk of crime	Hillier and Shu (1998) Shu (2000) Hillier (2004) Hillier and Sahbaz (2009)

The review of international policy and guidance documents revealed several areas of contention regarding through-movement and connectivity. Manual for Streets (Department for Transport, 2007) highlights that street networks should be connected to encourage walking and cycling and that connectivity within and between developments is important. Secured by Design New Homes (ACPO Secured by Design, 2010), on the other hand, reiterates the research evidence that high levels of connectivity create opportunities for criminals. While only one UK guidance document actually discouraged the use of culs-de-sac (CABE, 2009) several raised concerns regarding the limits this design places upon walkability. The review also highlighted a divergence between guidance and research related to culs-de-sac size and layout. Secured by Design New Homes (ACPO Secured by Design, 2010), Manual for Streets (Department for Transport, 2007) and Safer Places (Office of the Deputy Prime Minister and the Home Office, 2004) each highlighted how culs-de-sac are an acceptable design, but must be short, linear and not linked by footpaths. However, Johnson and Bowers (2010) highlight how sinuous (curvy) as opposed to linear culs-de-sac experience less crime (although both experience less crime than through roads).

The impact of connectivity and through-movement on levels of police recorded crime

As was highlighted within the methodology, the Macro analysis looked at crime levels on 34 developments which had been included in CABE's Housing Audits. The analysis looked at the relationship between levels of crime and particular design features – as judged by CABE's Housing Audit Assessors. The questions that were relevant to the theme of connectivity were:

- Does the layout promote use of the street by those not in cars?
- Does the building/spatial layout take priority over road layout?
- Does the scheme integrate with existing roads, paths and developments?

These questions were aggregated together to create a 'layout' score. The analysis revealed that for total crime, burglary, vehicle crime and criminal damage, high scores on the layout criteria acted to increase crime. Therefore, developments which achieved the highest scores for a) integration with existing roads, paths and developments; b) promotion of non-car travel, and c) ensuring roads do not dominate the spatial layout – were more likely to experience higher crime. For total crime, a one unit increase on the layout score resulted in a 16% increase in crime. For burglary, a one unit increase in the layout score resulted in a 14% increase. For vehicle crime the increase was 17%, and for criminal damage the increase was 55%.

The Micro analysis looked at the crimes experienced by 2193 properties located on 12 developments. The sample sites presented a variety of street layouts and across the whole sample, 54.5% of properties were situated on a cul-de-sac, compared to 45.5% on through roads. The analysis utilised data collected by the fieldworkers with the Environmental Features Checklist to establish which particular design features were associated with higher levels of crime. The analysis supported that revealed by the Macro analysis, revealing that the safest road layout was the true cul-de-sac (that with the least connectivity), followed by the through road, with the least safe road layout being the leaky cul-de-sac. The results found that, compared to the true cul-de-sac (the safest), through roads experienced 93% more crime and leaky culs-de-sac 110% more crime.

The analysis also identified that crime risk was generally lower on sinuous compared to linear culs-de-sac (replicating Johnson and Bowers, 2010).

As was highlighted within the methodology, in addition to the statistical analysis of police recorded crime data, the research included interviews with key personnel from each of the Micro sample sites as well as detailed fieldworker observations (this is often referred to as qualitative data). The following section highlights the key issues which emerged from the qualitative analysis in relation to the impact of connectivity and through-movement on crime.

Emerging issues

Road Layout

One of the key findings to emerge from the research was that cul-de-sac layouts (where true) were the safest design option, with leaky culs-de-sac the least safe. The research also confirmed (in line with recent research conducted by Johnson and Bowers, 2010) that sinuous culs-de-sac are safer than those with a linear layout. In general, the participants felt that culs-de-sac portray the impression to potential offenders that they are entering a private area – increasing the likelihood that offenders will feel uncomfortable entering the development. There were, however, exceptions to this, and several extremely permeable developments had created a strong sense of ownership and territoriality, whilst maintaining a high level of connectivity. In the particular case studies this had primarily been achieved via consistent and detailed design to ensure routes were well overlooked, designed to a high quality and managed and maintained robustly. Participants acknowledged that such designs can be successful but stressed the need for caution in replicating them in different contexts. In particularly, the social buy-in, community involvement and management and maintenance approach which these neighbourhoods had developed were viewed as an essential ingredient in the success of these more permeable designs.

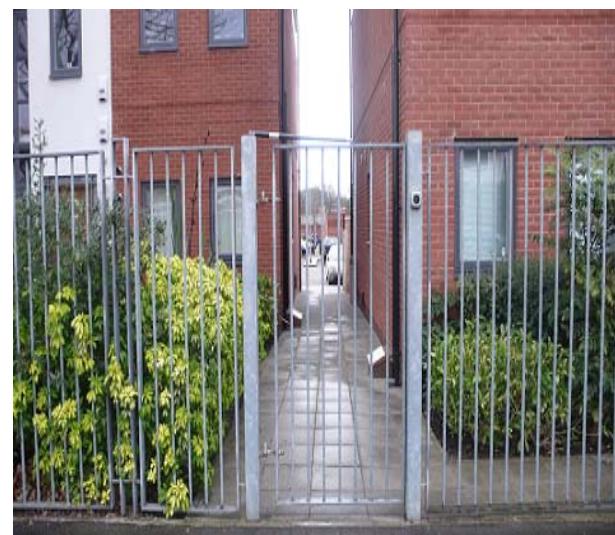
Developments which were highly permeable yet had maintained a sense of ownership and social buy-in^{viii}.



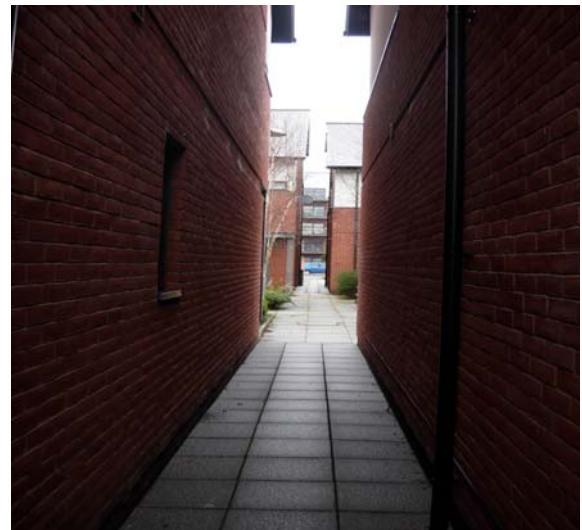
Gated developments

The sample included two gated developments – one for which the whole site was gated, the other including small gated area within a wider development. The results revealed that, not only were these developments unpopular with the local planners, they were also unsuccessful in reducing crime. The planners who took part in the research expressed the view that the solution of physically gating an area would be unlikely to be repeated in future developments, and that the desired sense of privacy could be achieved through more subtle techniques such as a narrowing of the road entrance or a change in road colour and texture.

One of the main problems with the gated developments included within the sample was that, although gated at the boundary, once inside, these developments were highly permeable with an abundance of alleys and pathways which were narrow, dark and with little or no surveillance from surrounding properties.



Once inside the gated development alleys are dark, narrow and not overlooked by surrounding dwellings.



Another issue to emerge was that, although these developments were gated, the poor positioning of street signs, utility boxes and street furniture meant that the gates could easily be scaled. In fact, it could be argued that the gates themselves act to entice offenders into the area – portraying an image that the development contains valuable possessions which require additional protection.

Lack of consideration for security in the positioning of street signs and utility boxes provides climbing aids for offenders.



Footpaths

The sample contained developments with a mix of layouts and a range of levels of connectivity. The research revealed several key findings relating to the provision of footpaths within residential developments, with the key issue being that footpaths can be included as long as they are designed with consideration for safety and security issues.

Cross referencing of crime locations and environmental features revealed that crimes were consistently clustered around alleyways and footpaths. Properties were particularly vulnerable when footpaths allowed access to the rear or side of the dwelling, where footpaths were not overlooked by surrounding dwellings and where footpaths were not well used. Corner plots located next to footpaths were also highlighted as vulnerable to crime.

Footpaths should not run at the rear or side of properties and should be direct, well-lit and overlooked.



Two developments in particular contained examples of properties which bounded footpaths and had either experienced high levels of crime, or the property owner showed signs of high levels of concern regarding crime. In the case of the former, the analysis of police recorded crime modus operandi revealed that offenders were entering the property via the boundary wall leading from the footpath (left hand picture). In the case of the latter, one resident whose property bounded a footpath had fitted many retrospective security measures such as barbed wire, CCTV cameras and anti-climb paint. Although this property had not experienced high levels of police recorded crime, the resident clearly shows concern regarding crime or ASB.

Properties which bounded footpaths were particularly vulnerable to crime or high levels of fear of crime.



Although the presence of footpaths often caused concern, as was highlighted above, the research revealed that footpaths can be included within residential developments if safety and security is considered in the design and layout. Footpaths within one development had been explicitly designed, named and publicised to encourage pedestrian and cyclist through-movement. Police expressed concern regarding the number of footpaths within the estate but acknowledged that their careful design - connecting people directly to destinations, ensured they were frequently used. In addition to ensuring that they were well-used, the avoidance of footpaths to the rear of properties appears to have limited the criminogenic potential of footpaths within this development which experienced no burglary dwelling offences within the three year period of analysis. A key finding to emerge from the research was that, where footpaths are required (and therefore well-used), wide, well-lit, direct and located at the front of properties, they can be included within a development without increasing the crime risk.

Footpaths should be located at the front of properties and be wide, well-lit and direct.



Another finding to emerge was that where developers had either deliberately or unintentionally restricted pedestrian movement, residents frequently created their own short-cuts. This was observed at one development where the street layout had ignored existing desire routes. In response, some pedestrians climbed over high fences in an attempt to access the development (confirming this, one person was observed climbing the fence during the site visit). Similarly at another development pedestrians had created a short-cut through a gap in railings, giving access to other footpaths leading to the city centre and other residential and commercial areas. Unofficial short-cuts will not be subject to any maintenance and are unlikely to be adequately lit or overlooked. Where the short-cut is through a residents' garden (as with the picture below) this also risks neighbour disputes and heightened fear of crime. Designs which restrict pedestrian movement, therefore, risk prompting the development of desire routes that are far more criminogenic than deliberately designed-in alternatives.

Where existing desire lines are ignored, residents are likely to create their own short-cuts.



The conclusions and recommendations

The impact of connectivity on levels of crime and disorder has dominated the designing out crime agenda, leaving practitioners with little clear guidance as to how to design out crime in practice. Culs-de-sac have been encouraged by some (on the grounds of crime reduction) and discouraged by others (on grounds of access to facilities and promotion of non-car travel). Others neither encouraged nor discouraged their use, but stressed the importance of avoiding connecting footpaths (leaky culs-de-sac) and ensuring that, where present, they must be designed with consideration for crime reduction. Overall the evidence base relating to through-movement/connectivity and levels of crime is consistent. Research conducted with varied methodologies has supported the hypothesis that high levels of connectivity and through-movement contributes to higher levels of crime, with true, sinuous culs-de-sac experiencing the lowest levels of crime. The exceptions are the majority of studies conducted using Space Syntax methodologies.

This study confirmed that sinuous, true culs-de-sac experienced the lowest levels of crime and highlighted the clustering of crimes around footpaths, alleyways and access paths to properties. However, one of the key findings was that footpaths can be included within residential developments as long as they are designed in accordance with crime reduction guidelines and in close consultation with police ALOs/CPDAs. Where footpaths are included within a development they must be required/desired (and therefore well used), short, direct, wide, overlooked, well-lit and should not run at the side or rear of properties.

Key recommendations emerging from the research include:

- Residential developments should limit connectivity and through-movement. However, where footpaths are required within a development, they must be desired/well-used, short, wide, well-lit, overlooked by neighbouring properties and must not run at the side or rear of properties.
- Sinuous, true culs-de-sac are the safest road layout and should be encouraged.
- Leaky culs-de-sac should be avoided.
- Pedestrian desire lines should be identified and well considered footpaths should be designed into the development. To ensure footpaths are well used they should connect the locations residents need to reach, be suitably maintained and adequately lit.
- Gating a development is not an adequate crime prevention measure on its own. It does not absolve a design team from designing carefully within the perimeter to ensure the scheme as a whole reduces crime opportunities. Also where developments are gated, care must be taken to ensure that the boundary is not compromised by the positioning of street furniture which can act as a climbing aid.

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ⁱⁱFrom 1 April 2011 CABE became part of the Design Council and operates as Design Council Cabe

ⁱⁱⁱThe research resulted in a 500 page final report.

^{iv}The Applied Criminology Centre at the University of Huddersfield; Professor Ian Colquhoun; The Design Against Crime Research Centre, Central Saint Martins College of Art and Design; The Midlands Centre for Criminology and Criminal Justice, University of Loughborough; The Design Against Crime Solution Centre, University of Salford and Nottingham Trent University.

^vA Sinuous cul-de-Sac is defined by Johnson and Bowers (2010) as: Property is located on a road which leads to a dead-end AND is non-linear in geometry so that there is little visibility down the road from the road to which it is connected OR the road is linear in geometry BUT the road to which you turn off to access the cul-de-sac is NOT a through road. A Linear cul-de-Sac is defined as: Property is located on a road which leads to a dead-end AND is linear in geometry so that there is visibility to the end of the cul-de-sac from the road to which you access the cul-de-sac AND the street is one turn off a through road.

^{vi}Integration being an indicator of how easily you can reach a specific line – the average number of spaces needed to pass through to reach a specific line for all axial lines in a system.

^{vii}It should be highlighted that one study (Nubani and Wineman, 2005) revealed findings which conflicted with the remaining Space Syntax studies.

^{viii}The Macro analysis relied upon CABE Housing Audit scores and subscores for detail on design features, therefore it is not possible to provide detail on their reasoning.

^{ix}All photos should be credited to Leanne Monchuk and Ian Colquhoun.