

A SYSTEMATIC REVIEW OF ACCESS CONTROL AS A METHOD TO REDUCE CRIME IN PHYSICAL ENVIRONMENTS

Review Protocol

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1. ABSTRACT

This document provides the background to and reasons for undertaking a systematic review of the evidence relating to the effectiveness of access control as a method of reducing crime in physical environments. It outlines the questions that the review hopes to answer and the methods through which relevant studies will be identified, appraised and synthesised. A novel feature of this review is the attempt to combine the principles and processes of two distinct approaches to evidence synthesis: meta-analysis, most associated with Cochrane and Campbell Collaboration systematic reviews (see Sackett *et al.* 1996; Petrosino *et al.* 2001) and realist synthesis (Pawson and Tilley, 1997; Pawson, 2006). This is one of several systematic reviews to be conducted as part of *Work Package 2* of the *What Works Centre for Crime Reduction*, hosted by the UK College of Policing. Since each of these reviews hopes to combine these two approaches, unlike the standard format for systematic review protocols, this document also sets out why and how we intend to marry these two review methods and the additional benefits – to research and crime prevention policy and practice – we hope to achieve from doing so.

2. BACKGROUND

‘Access control’ can broadly be defined as the selective restriction of access to or use of places, people, targets and resources. Access control methods are commonly used as a means to reduce crime. They are arguably one of the earliest known forms of crime reduction. The Great Wall of China began construction in the 7th Century BC and was designed, amongst other things, to thwart invading Huns. Drawbridges similarly control access. Many a castle has avoided a siege through the use of such devices. Likewise ‘sentries’, originating in the early seventeenth century and defined as ‘a soldier stationed to keep guard or to control access to a place’, can be considered an access control measure (Oxford Dictionary, 2014). Access control is also widely used in the animal kingdom in the interests of survival and to avoid predation; think of birds’ nests or rabbits’ burrows.

Over time the type and scope of access control measures has grown considerably in tandem with advances in science and technology. Examples include:

- Car park barriers

- Fenced yards
- Entry phones
- Electronic card access
- Screening passengers
- Baggage screening
- Fingerprint recognition (and other biometric attributes) to prevent illicit access to crime-prone places

There are many crimes that may be addressed through access control methods, for example: domestic burglary; hijacking of airports and aircraft; theft of weapons and arsenals; commercial robbery; fraud and internet sites; shop theft and shopping malls; theft of and from boats and marinas; and damage to plants and parks. In regard to very specific problems a range of access controls may be adopted. For example, the theft of lead from church roofs may be reduced by limiting access to church ladders and wheelie bins that might otherwise be used to reach the roof. Access to the car park might also be restricted to increase the effort associated with loading the stolen lead and driving away.

3. THEORETICAL UNDERPINNINGS

A number of theoretical perspectives provide a rationale for access control as a method for reducing crime in the physical environment. These include the following.

Crime prevention through environmental design

Some of the earliest discussions on access in the context of crime prevention can be found in the writings of Jane Jacobs, C. Ray Jeffrey and Oscar Newman on the role of urban design in crime. In her seminal publication, *The Death and Life of the Great American Cities* (1962), Jacobs, an urban planner, called for the design of more permeable urban environments that better facilitate public access and opportunities for surveillance. This was grounded in the assumption that increasing the number of people passing through an environment – so-called “eyes on the street” – can act as a mechanism to reduce crime by increasing the (perceived) risk of being detected, thereby deterring prospective offenders through what Jacobs calls “natural policing”. For Jacobs, widening access improves the control of those who might otherwise commit crime.

A decade later, Newman (1972) considered how different building designs and their configuration can reduce ambiguity as to who should be found at particular places, and who should be responsible for them. In contrast to Jacobs, Newman saw strangers as a source of danger not security. He advocated that access to places be limited to residents (or other capable guardians) who should take ownership of them. He argued that designs that encourage a sense of ownership ('territoriality') create 'defensible spaces', whereby heightened vigilance and responsibility on the part of residents, real or perceived, can thwart prospective offenders.

Jacobs and Newman clearly hold divergent views on how the designs of urban environments affect crime. What they both share is the notion that access is causally related to crime. The same can be said of the enduring debate in environmental criminology (see Wortley and Mazerolle, 2008) on crime and the permeability of street networks. Several studies using space syntax – an urban modelling approach used to assess pedestrian movement – suggest that burglary tends to concentrate on street segments that are less accessible, most notably culs-de-sac (Hillier, 2004; Hillier and Shu, 2000). Consistent with Jacobs, this is attributed to a lack of 'natural policing' as a consequence of design-induced poor sightlines and limited pedestrian through-put (but see, Nubani and Wineman, 2005).

This runs counter to the findings of other researchers (*e.g.* Beavon, Brantingham and Brantingham, 1994; Johnson and Bowers, 2010) who, using a range of methodologies, conclude that the permeability of the street network *increases* burglary risk, thus suggesting that culs-de-sac exhibit lower risks of burglary. Several access-related causal mechanisms might account for this finding. First, greater permeability affords easier access and escape routes for prospective offenders. Second, increased footfall on a given street as a function of greater permeability means that it becomes part of the 'awareness space' of more people, some of whom are liable to offend as they come to appreciate available crime opportunities (Brantingham and Brantingham, 2008). Related to this, increasing the supply of people passing through an area will, all things being equal, increase the likelihood that motivated offenders will encounter suitable targets in the absence of capable guardians, as outlined in the routine activity approach (Cohen and Felson, 1979). Third, and consistent with the logic of Newman, increased through-movement may be associated with increased anonymity that effectively cloaks crime and reduces surveillance opportunities (Poyner and Webb, 1991).

Crime Prevention Through Environmental Design (CPTED) (Armitage, 2013) and Secured by Design (SBD) have evolved from such thinking. Access control lies at the heart of both approaches, typically through the hardening of potential targets of crime. This takes us to situational crime prevention.

Situational crime prevention

Situational crime prevention (SCP) is concerned with reducing opportunities for crime. The first formulations of SCP emerged in the mid-1970s (Mayhew *et al.* 1976; Clarke, 1980) as an alternative to prevailing criminological thinking that focussed on the presumed *distal* causes of crime - such as upbringing, poverty and schooling - and sought to reduce crime by altering offender motivation, either prospectively for individuals judged to be at high risk of criminal involvement or retrospectively for convicted offenders in a bid to reduce reoffending. By contrast, SCP is concerned with the causal role that opportunities in the immediate environment might play in crime events. It seeks to develop opportunity-reduction measures that are “(1) directed at highly specific forms of crime, (2) involve the management, design and manipulation of the immediate environment in as systematic and permanent a way as possible, and (3) make crime more difficult and risky, or less rewarding and excusable as judged by a wide range of offenders” (Clarke, 1997, p. 4).

There is now an extensive and accumulating body of evidence using a variety of methods that shows the effectiveness of preventing crime through opportunity reduction (for case studies, see Clarke, 1997). Such interventions can take many forms and are often categorized according to the causal mechanisms through which they are expected to work: by increasing the perceived effort on the part of prospective offenders, increasing the perceived risks, reducing the perceived rewards, reducing provocations and removing excuses.

Access control constitutes one of the 25 techniques of SCP, organised under the banner of increasing effort (Cornish and Clarke, 2003). It is also one of the most common. In his review of 206 published evaluations of SCP measures between 1970 and 2007, Guerette (2009) found that 18% of interventions designed to increase offender effort could be defined as controlling access second only to target hardening (24%). In some cases, the terms ‘access control’ and ‘target hardening’ are used interchangeably and distinguishing one from the other can be tricky; robust bolts on the doors of a property clearly limit unwanted access and

in doing so protect the items inside from theft and damage. Yet the two concepts are not one and the same. Steering wheel locks and immobilisers make it harder to steal a motor vehicle inconspicuously, but do not alter the ease with which such cars can be accessed. To assist in delineating access control from target hardening, Ekblom (2011, p. 13) usefully separates *targets*, defined as “the property or people deliberately stolen, damaged or injured as the end goal of crime” from *target enclosures*, such as “safes, rooms, buildings or compounds”. For the purposes of our review, we are interested in the latter, restricting access to target enclosures.

Conditionality and effectiveness of access control

Like any other crime prevention measure, those which are expected to work through restricting access require favourable conditions to bring about the sought after outcomes. Examples where this is less likely include scenarios where the source of the threat is internal (*e.g.* theft by employees), where there is internal/external collusion (*e.g.* where routes of cash in transit vans are shared with offenders), or where there are determined offenders (such as terrorists) alongside easily sidestepped access control measures. Additionally, many forms of access control in the physical environment rely on human action for them to operate as planned. For example, door locks need to be used for them to be effective.

Interestingly, the same principles underpinning access control as a method of crime reduction can likewise be exploited by offenders in the service of *crime commission*. Eck (1994) describes how drug dealers may prefer apartment buildings whose design and configuration afford greater access control. Atlas (1990) uses the term *offensible space* to describe criminals’ artful use of deadbolts, peepholes, security bars, spotters, lookouts and booby-traps to avoid a) predation by fellow offenders, b) contact with those who might inform on them or c) easy police access.

The delivery of access control

The delivery of access controls is effected in different ways: through passive physical obstacles, such as fences and walls; human-activated physical obstacles such as doors, gates and draw-bridges; and human-operated access (using keys, cards or codes) to automated obstacles, such as self-closing barriers. Animals sometimes also control access. For example,

dogs may bark at or bite prospective intruders. They may sniff out restricted substances or dangerous persons to alert humans to the need to intervene. In some cases, multiple access controls operate in tandem to complement one another. Airports, aircraft and border controls in general comprise examples with which most of us will be familiar. Here access controls are designed around people who might comprise a threat, illicit drugs, contraband goods that might be taken across borders, people who might be smuggled, and weapons that might be used either in transit or at the destination. Access control is delivered via barriers, repeated checks on documentation, matching persons to documentation, screening baggage and persons, and sometimes dogs that might smell out drugs, explosives, or other contraband.

Classifying access control measures

Access controls as methods to reduce crime can be categorised in myriad ways, for example:

- *By causal mechanism, i.e.* the means through which an intervention might reduce crime. In SCP terms, this is most often through increasing the effort on the part of prospective offenders accessing the area of interest (broadly defined). Yet crime prevention through access control is not limited to this. Access control can afford greater opportunities for surveillance thereby increasing the probability that an offender is identified (à la Jane Jacobs). It can also reduce provocations by separating groups of individuals liable to clash if in close proximity to one another (such as opposing football fans or patrons in a busy bar). It can remove excuses for entering private space with signs indicating who is and is not eligible to enter.
- *By setting, i.e.* the types of environments in which access control methods are implemented. This can be considered at various levels. One obvious distinction is between physical and cyber environments. This review focusses solely on the former. However, it is important to note that access control methods are frequently used to prevent illegal and/or unwanted behaviours in cyberspace. There are also various sub-levels of physical environments in which different access control methods might be employed and causal mechanisms expected, such as residential settings, retail and recreational environments and other public spaces.

- *Permanency*: Some access control measures are permanent barriers that close off a once permeable/semi-permeable access point. Others are momentary or episodic barriers, employed either at certain times of the day or year or at the specific behest of individuals concerned.

- *Targets of access control*. Access control can be targeted at:
 - a) (Potential) offenders: keeping out, increasing the risks or reducing the capability of those who might be motivated or tempted to commit crime. The inclusion of *potential* is important. Consider football-related violence around stadiums. Access control methods are routinely used to reduce provocations facilitated by opposing fans coming into contact with one another before or after the game. These groups (in the main) most likely do not attend football matches with the intention of engaging in fights with opposing fans but conducive conditions can provoke such behaviours;
 - b) Targets of crime: protecting vulnerable people (such as the rich or famous), goods (most commonly those that are CRAVED; Concealable, Removable, Available, Valuable, Enjoyable and Disposable; Clarke, 1999¹), or places (*e.g.* people's homes, embassies, and so on);
 - c) Resources for committing crime: reducing the availability of tools that facilitate crime, such as guns, explosives, spray cans, or ladders, and/or
 - d) Pay-for-use facilities: reducing the scope to defraud the owner/custodian of the facility *e.g.* underground transport systems, theatres.

In sum, several theoretical perspectives, most notably those associated with environmental criminology, identify access as a causal factor in crime. Access control is duly observed as a widespread form of crime prevention. It is applied to different crime types, targeted at different units at risk and takes numerous forms. However, despite its common usage, systematic evidence on the effectiveness of access control as a way to reduce crime in the physical environment is limited. It is regularly claimed that access control “works” but this assertion is at such a high level of abstraction as to be banal and of little relevance to those tasked with reducing specific types of crime in particular problem contexts. By contrast, there

¹ Related to CRAVED, in their original formulation of the Routine Activity Approach, Cohen and Felson (1979) presented the acronym VIVA, a target-oriented model to describe those factors associated with a heightened risk of victimization: *Value, Inertia, Visibility* and, most relevant here, *Access*.

is some quite convincing evidence on the effectiveness of particular access control measures that have been applied to specific sub-categories of crime, such as alleygates introduced to increase the effort associated with burglars gaining access to residential properties to commit burglary in several neighbourhoods in Liverpool (Bowers, Johnson and Hirschfield, 2005). Our aim in this review is systematically to synthesise the evidence available to discover what has been found about the effectiveness of access control in all its forms and in the various types of physical environment in which it is implemented. By incorporating meta-analytical methods with a realist synthesis, we also aim to elicit and test working theory relating to whether and how access control may reduce (or increase) crime in the physical environment and under what conditions.

4. THE APPROACH OF THIS SYSTEMATIC REVIEW

The first objective of this systematic review is to assess the evidence on whether access control has been found effective as a method of reducing crime in the physical environment. The second is to tease out how, in what form(s), for what crime types and under what conditions access control has been found to be effective, ineffective and to produce unintended negative effects.

In order to meet these objectives we aim to marry meta-analysis with realist synthesis. Thus, in addition to asking whether access control has or has not been found to be associated with greater or lesser reductions (or increases) in crime (as would be the primary objective of a meta-analysis), we will also ask what the available evidence can tell us about which access control techniques have reduced which crimes under what conditions and how (the primary objective of a realist synthesis).

More specifically, the review aims, therefore, to generate evidence regarding:

- a) The techniques used to try to control access for the purposes of crime reduction in physical environments (for example gates used to restrict access to residential alleyways);
- b) The causal mechanisms through which access control techniques have been found (positively or negatively) to affect crime, and whether these mechanisms vary

substantively by crime type and/or specific sub-groups intended to receive the intervention (for example making access to crime targets more difficult or more risky for domestic burglars, real or perceived);

- c) The conditions found to be (more or less) conducive to the activation of causal mechanisms identified in (b) (for example the conscientious closure and locking of (alley)gates);
- d) The conditions found to be required for (or to rule out) implementation of access-blocking interventions of the kind identified in (a), (for example, available funding and key stakeholder agreement for the installation and maintenance of the alleygates);
- e) Where possible, the degree to which access control measures taken are cost-effective/otherwise beneficial as well as effective at reducing crime;
- f) The patterns of (positive and negative) crime-related outcomes produced by (a)-(e) (for example reduced rear access rates of burglary with displacement or diffusion of benefits to other burglary entry points or relevant targets).

As alluded to previously, this systematic review is being conducted as part of *Work Package 2* for the *What Works Centre for Crime Reduction*. It is worth noting at this point that the items listed above are expected to align with the criteria to be developed in *Work Package 3*, which aims to produce a standard method of assessing the comparative effectiveness of crime prevention interventions. Moreover, question (e) is of relevance to *Work Package 5*, which attempts to provide practitioner-oriented guidance on costing crime prevention interventions.

Reasons for marriage: A rationale for combining meta-analytical and realist perspectives in a systematic review

Questions (a) to (e) above are not routinely asked in systematic reviews of crime prevention interventions. We argue they should be. Our interest in them is based on the assumption that knowledge of “what works” (or has been found to work) is insufficient for those interested in

intelligently applying the findings from evidence syntheses in future crime reduction efforts, mindful of the variation in available resources dedicated to crime prevention as well as the many and messy contexts into which crime reduction measures are implemented (Tilley, 2006; Laycock and Tilley, 1995). Reliable evidence on the statistical association between intervention and outcome must be accompanied by (tested) working theories on the causal chain(s) that links intervention to outcome.

In recent years there has been much debate on the advantages and disadvantages of different types of systematic review (see Dixon-Woods *et al.* 2005) and how to reliably distinguish one form of review from another (Gough, Thomas and Oliver, 2012). Debate has also focused on the merits and methods of integrating contrasting forms of evidence review, such as combining meta-analytic methods most associated with Cochrane and Campbell Collaborations (see Petrosino *et al.* 2001) with the principles and methods of realist evaluation (Pawson and Tilley, 1997), an approach which places greater emphasis on the causal mechanisms responsible for outcome patterns and the contextual conditions under which those mechanisms operate (or do not do so). Published reviews in criminal justice combining these two approaches are, however, limited. An exception is van der Knaap *et al.* (2008) who report a systematic review of interventions to reduce violence in public and semi-public spaces. The combined approach which they use begins with a literature search using pre-determined search strategies and ranking the identified studies using the Maryland Scientific Methods Scale (SMS, Sherman *et al.* 1997): level 5 (the best) denoting an Randomised Controlled Trial (RCT) and level 1 (the worst) a simple correlation analysis. Unlike many systematic reviews of the crime prevention literature, van der Knapp *et al.* (2008) do not exclude studies based on their rating on the SMS. Following quantitative analysis to synthesise the evidence, the amassed studies were analysed from a realist perspective in a bid to identify some of the contexts and mechanisms that appeared to be responsible for the outcome patterns observed. As the authors write, “this proved to be rather difficult, for a lot of information [pertaining to the principles of realist evaluation] was missing...often, no explicit theory describing underpinning the intervention, and information on mechanisms and context was scarce” (van der Knaap *et al.* 2008, p. 54). Despite this, they found the process helpful in eliciting and better understanding the causal mechanisms through which the reviewed interventions were expected to operate.

5. REVIEW METHODS

This section describes the methods to be used in this systematic review. It begins with an overview of the strategy to be undertaken, in particular how the proposed methods speak to both meta-analysis and realist synthesis. This is followed by a description of our criteria for inclusion, strategy for identifying studies, search terms, data extraction and management processes, and the statistical analyses to be performed in the meta-analysis.

Brief overview of review process

As illustrated in Figure 1 below, our review is expected to unfold as follows. Relevant databases (including the grey literature, see pp. 20-21) will be searched using pre-determined search terms (pp. 23-24). Identified studies will initially be screened through reading the title and abstract to remove those that are unsuitable based on our inclusion criteria (pp. 18-19). Crucially, as we will explain below, the inclusion criteria for the realist synthesis differ from those for the meta-analytical branch of this review. For example, to be included in the meta-analysis, a study must report a quantitative crime-relevant outcome measure (following the implementation of an access control intervention). For the realist synthesis broader inclusion criteria will be used. Those studies that meet the inclusion criteria for meta-analyses are then coded and relevant information extracted.

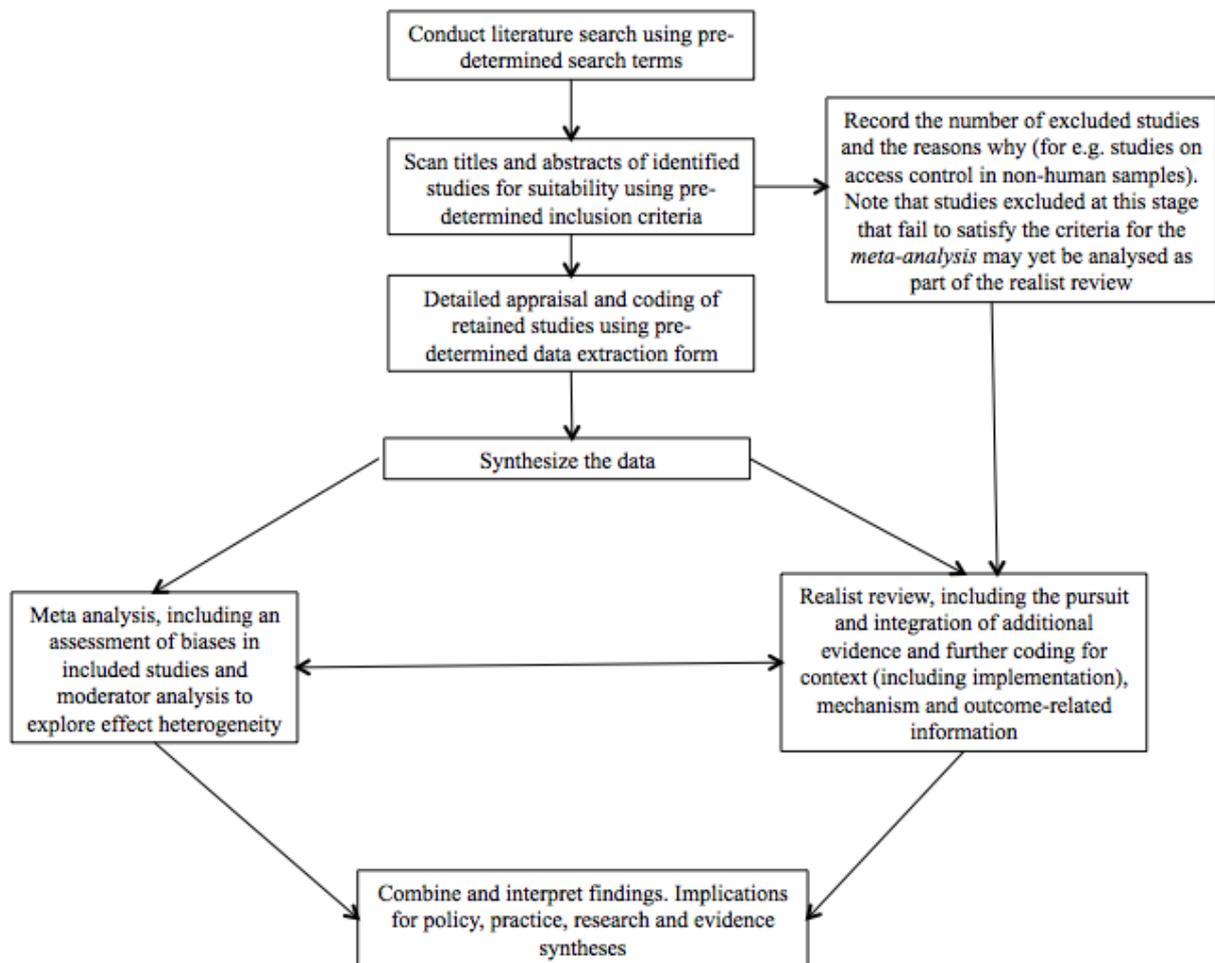


Figure 1: Flowchart of the Process to be followed in our Systematic Review of Access Control as a Method to Reduce Crime in Physical Environments

In simple terms, the two branches of our review can be thought of as centring on different - albeit related - questions. The meta-analysis branch (to the left of Figure 1) is primarily concerned with “what worked?” in the context of evidence on the effectiveness of access control as a method of crime reduction. The realist branch (to the right of Figure 1) draws on the same material as the meta-analysis as well as additional sources of evidence considered relevant, to answer the broader question “what works, how, for whom, and under what circumstances?”

Once the data extraction is complete, the same set of studies will be drawn on to follow two analytical paths, co-ordinated by two separate (but interacting) research teams. One is a meta-analysis, in which the studies will be quantitatively examined to determine the overall effect

size of the retained studies. Moderator analysis will be conducted to explore any heterogeneity in effect sizes observed across studies and differences between sub-groups. An assessment of potential biases (such as publication bias) in the retained studies will also be carried out. In parallel, the same studies (plus additional ones) will be analysed from a realist perspective. This will involve a detailed reading of the selected studies with a view to eliciting working theories as to how access control is expected to effectively reduce crime in the different physical environments in which they have been applied. There are several features to the realist analysis that warrant mention:

- a. It will involve some extra coding (focussing on additional criteria not included in the previous coding phase) pertaining to 1) the context in which access control measures were applied in the retained studies; 2) the causal mechanisms through which the access control measures were deemed to work, and where possible the coding of intermediate outcomes that would be expected if a particular mechanism were at play; 3) implementation-relevant information and 4) outcome patterns attributable to the access control measures that extend beyond net increases or decreases in crime. Such outcome patterns may include, for example, changes in non-crime measures such as public confidence in the police or fear of crime. While nuanced coding categories will be generated in a bottom-up fashion to help summarise emerging themes, the coding will also be binary, indicating whether studies do or do not report such items. We consider this to be an important element of any systematic review: informing not just what we already know but what we need to know. More specifically, we expect this information to usefully inform the development of reporting guidelines for criminological studies, should it emerge that a sizable proportion of relevant studies make no mention of these issues. Presently, reporting guidelines for criminological research have been mooted, drawing on established checklists in the health sciences, but not yet formally developed (see Sidebottom and Tilley, 2012; Perry, Weisburd and Hewitt, 2010). Growth in the use of systematic review methods in criminology suggests that the development of reporting guidelines is timely. The research conducted as part of the “What Works?” project is expected to advance this agenda.
- b. In the spirit of realist evaluation, should evidence or information gaps emerge in the process of analysing the identified studies, this will initiate a further purposive search for relevant evidence. This pursuit of cognate evidence hitherto unidentified in the

search process is intended to furnish a richer collection of information of relevance to reducing crime through blocking access (regardless of the type of evidence (quantitative or qualitative) or research design employed), and to help build and refine underlying programme theories. To illustrate what is meant by sourcing additional relevant evidence, consider a hypothetical scenario in which a study described how various signs, designed to alert prospective offenders of a new crime prevention scheme, failed to be noticed by the target audience and thereby failed to produce the sought after crime reduction outcomes. This is an example of implementation failure: signs may well be an effective means of deterring offenders but their effectiveness is conditioned on prospective offenders firstly seeing the signs and secondly, changing their behaviour in the desired manner (*i.e.* not engaging in crime). Now imagine that a detailed reading of this case study indicated that the signs were implemented next to a raft of extant signs, relating both to past crime prevention schemes as well as various other public announcements. Here, we may want to probe different literatures to determine how best to overcome the problem of “sign blindness” and reduce the likelihood that the target audience fails to notice the crime prevention publicity. This might usefully inform future strategies that seek to implement similar crime reduction measures. In realist terms, this would relate to the conditions necessary to activate the causal mechanism believed to be responsible for producing the outcome of interest.

Further, studies identified in the initial searches may be silent on issues of implementation – something that would be important to practitioners seeking to implement crime prevention interventions. Other studies, which fail to meet the inclusion criteria for meta-analysis, might provide useful guidance on such matters. For example, in their article on the implementation of alley-gates, Johnson and Loxley (2001) do not evaluate a particular intervention (which would lead to the exclusion of this article according to the initial meta-analysis inclusion criteria) but draw together information on the implementation of such schemes, including legal and practical issues that would need to be considered by practitioners seeking to implement them. The realist arm of the review would aim to identify such studies.

We recognise that additional searching of the sort described above has the potential to be very demanding, and we will be limited by the time and resources available. Our hoped-for goal, following Pawson (2006), is to marshal sufficient evidence to build,

refine and test theories judged to underlie the intervention under review (here access control in physical environments) until the point of “theoretical saturation”, whereby consensus is reached that sufficient evidence has been gathered to answer the review question(s). We also recognise that this type of review is not linear, but describes an iterative procedure, with feedback loops potentially taking researchers back to literature that they considered earlier in the process. This flexible searching for evidence that can inform theory lies at the heart of realist approaches.

It must be stressed that we do not envisage these dual – realist and meta-analytic – processes as being independent. On the contrary, we expect the emerging findings from one branch of evidence synthesis to inform and be informed by those from the other. We see this as being particularly likely with respect to the testing of explanations for any heterogeneity in effect sizes observed across studies. Briefly, reviews into the effectiveness of crime prevention interventions invariably uncover substantial differences between studies, types of interventions, time periods, population groups and so on. Heterogeneity in effect sizes is the norm. Fittingly, moderator analysis has come to be standard practice in systematic reviews (most notably meta-analyses) in an attempt to locate the source of and reasons for sub-group differences. This typically involves partitioning the accumulated data (and hence studies) into meaningful subsets so as to calculate mean effect sizes.

Presently, the choice of variable on which moderator analyses are conducted tends to be determined by tradition and convenience as opposed to generative causal mechanisms judged to be responsible for the outcome patterns observed (or not). For example, regardless of the question under review, moderator analysis typically sifts the data to determine any significant differences by, say, study location, intervention type and study design. These findings are clearly of scientific interest and may reveal interesting results, although the risks of *post hoc* atheoretical partitioning have been long recognised in the meta-analyses of medical trials (*e.g.* Peto *et al.* 1995; Rothwell, 2005a; 2005b). Moreover, such analysis may be less relevant to those consumers of the evidence, most notably policy-makers and practitioners, interested in the ways in which the findings may be applicable to the practicalities of preventing crime in their particular setting. This is again an issue that has been stressed in clinicians’ discussions of the use of meta-analysis of trials in their medical practice (*e.g.* Horowitz, 1987, 1995; Feinstein 1998; Davidoff 2009). As alluded to above, the aim of the realist branch of

our review is to uncover and test working theories as to how and under what conditions access control will reliably reduce (or fail to reduce) crime. To this aim, it is our hope that a realist perspective might inform a theory-driven and also more practically meaningful moderator analysis. In particular, it aims to generate theoretically warranted analysis of sub-groups.

Where *post hoc* moderators are introduced in the meta-analysis in light of evidence of heterogeneity in outcomes uncovered across multiple trials, the realist branch will try to explain the findings and also to search out further data that might be drawn on to test the explanations by reference to the distinct expected outcome signatures (Johnson, Birks, McLaughlin, Bowers and Pease, 2007; Eck and Madensen 2009; Pawson and Tilley 1997). As with any systematic review, the extent to which meaningful moderator analyses can be conducted will be determined by the number of studies meeting our inclusion criteria and the data available from them.

Each branch of our review is intended to produce different but complementary outcomes. The realist branch aims to elicit working theories on how access control is expected to reduce crime in physical environments and the conditions most favourable to doing so. It will also provide quantitative information on the extent to which the identified studies report information pertaining to contexts (including implementation and stakeholder involvement, roles and responsibilities), causal mechanisms and outcome patterns. Complementary to this, the meta-analytical branch will report evidence on the mean effect size of the access-blocking interventions reviewed as well, where possible, as for sub-groups within the data, in particular as predicted as a result of the realist review.

Criteria for considering studies for this review

In selecting studies for this review we will use the following criteria:

- a) Studies must include access control as the major technique of crime prevention. The technique can be implemented by any stakeholder: law enforcement, government agencies, private entities, citizens, etc.
- b) Studies must take place in the physical environment. This is distinguished from the cyber or online environment. Any study reporting the effectiveness of access control

measures designed to reduce illicit or unwanted activities on the internet will be excluded².

- c) Studies must specify the crime(s) whose prevention is expected as a consequence of the access control measure or measures³.

In addition, to be included in the meta-analysis branch of this review, a study must:

- d) Report primary research; evidence reviews will be excluded.
- e) Report a crime-related quantitative outcome measure. The quantitative findings for any single study can be incorporated only once in the meta-analysis, even if reported in multiple publications. Where this is the case, that study which reports the most detailed information will be included or, where necessary any dependency in the data will be dealt with appropriately (see below page 28).

For the realist branch of this review, studies reporting information on any of the points below in addition to satisfying points a-c would also warrant inclusion:

- f) Reference to the implementation of the access control crime prevention measure, OR
- g) Evidence relating to crime-related causal mechanisms activated by the access control measure/s, OR
- h) Evidence relating to the conditions needed for the access control measure(s) to activate crime-related causal mechanisms, OR
- i) A theory of change linking the access control measure(s) and crime-related outcomes.

More generally:

- j) Published and unpublished studies will be included
- k) There will be no restriction by date of study
- l) Studies must be available in the English language. Available resources limit our ability to search and translate non-English access-control-relevant studies. To ensure that any key references in other languages are identified (though not coded), relevant

² We recognise that in some circumstances the physical and cyber world may overlap, as when physical measures such as electronic barriers are put in place to restrict access to computers (as is often seen in public libraries). As alluded to previously, in such cases, our interest in this review is with the *target enclosure* as opposed to the *target*, and thus with access to, say, the library computer room rather than access to the computer and the internet.

³ It is possible that a primary study might report “crime” more generally as opposed to specific types of crime. In the event such a study would be included.

experts from countries where English is not the first language will be contacted. These include:

- Frans Leeuw (Dutch)
- Ernesto Savona (Italian)
- Johannes Knutsson (Swedish, Norwegian)

Identifying studies: databases and information sources

Relevant studies will be identified using the following search methods:

- 1) A keyword search (see pp. 23-24) of relevant online abstract databases, including grey literature and dissertation databases (see pp. 21-22)
- 2) A hand search of key journals⁴
- 3) A hand search of outputs from key government, research and professional agencies. This step will involve personnel from the UK College of Policing who will search the National Police Library catalogue to help identify relevant research. This could be particularly useful in accessing unpublished research.
- 4) A hand search of conference abstracts published in the past two years (2012 and 2013) to identify ongoing studies or studies awaiting publication, namely the *American Society of Criminology*, *European Society of Criminology* and *British Society of Criminology* conferences.

To the best of our knowledge this is the first systematic review of the evidence on access control as a method of crime reduction in physical environments. Consequently, we are unable to follow the usual convention of reviewing the bibliographies of relevant reviews. However, we will conduct a forward search for publications that cite key articles (see Appendix). The finalised list will be checked by recognised experts in the field and an information specialist at Rutgers University (Phyllis Schultz) who has extensive experience in retrieving articles particularly from the grey literature in policing and crime prevention.

⁴ These journals are: *Police Practice and Research: An International Journal* and *Policing: a Journal of Policy and Practice*. Note that many of the major criminology journals are covered by the databases that will be searched in this review. The journals listed here do not routinely feature in such databases and will therefore be searched by hand.

Databases to be searched are:

1. ASSIA (Applied Social Sciences Index and Abstracts)
2. Criminal Justice Abstracts
3. Criminal Justice Periodicals
4. ERIC (Education Resources Information Center)
5. IBSS (International Bibliography of Social Sciences)
6. NCJRS (National Criminal Justice Reference Service)
7. Proquest theses and dissertations
8. PsycINFO
9. PsycEXTRA
10. SCOPUS
11. Social Policy and Practice
12. Web of Science
13. CINCH
14. Sociological Abstracts

We will also search the publications of ten prominent organisations associated with police and criminal justice research:

1. Center for Problem-Oriented Policing (Tilley Award and Goldstein Award winners)
2. Institute for Law and Justice
3. Vera Institute for Justice (policing publications)
4. Rand Corporation (public safety publications)
5. Police Foundation
6. Police Executive Research Forum
7. The Campbell Collaboration reviews and protocols
8. Urban Institute
9. European Crime Prevention Network
10. Swedish National Council for Crime Prevention

In addition, publications from prominent national policing agencies will be searched and the agencies contacted if necessary. These are:

1. UK Home Office
2. UK College of Policing (Polka)
3. Australian Institute of Criminology
4. Swedish Police Service
5. Norwegian Ministry of Justice
6. Canadian Police College
7. Finnish Police (Polsi)
8. Danish National Police (Politi)
9. The Netherlands Police (Politie)
10. New Zealand Police
11. US National Institute of Justice

Full text versions of identified studies will be obtained through one of the following means (in order of preference):

- a) Electronic copies via University College London e-journals service (UCL; as well as other electronic works accessible through other universities as part of a consortium, *e.g.* University of London Senate House Library).
- b) Electronic copies of studies available from elsewhere on the internet.
- c) Paper copies at UCL (as well as other electronic works accessible through other universities as part of a consortium, *e.g.* M25 consortium).
- d) Electronic/paper copies requested through UCL's Inter Library Loan (ILL) system, which sources most materials from the British Library.
- e) Electronic copies at the Gottfredson Library at the Rutgers University School of Criminal Justice (US).
- f) Electronic/paper copies requested from the authors themselves.
- g) The UK College of Policing library.

Should any of the full text versions of the works collated contain insufficient information to determine their eligibility for inclusion according to our coding strategy (described below), where practicable the corresponding author will be contacted in an attempt to retrieve this information.

Search strategy/terms

Unlike many other systematic reviews, our search strategy cannot be limited to a particular research design, intervention or population group. As mentioned previously, access control can take many forms, has been targeted at many crime types and applied in many contexts; and part of the ambition of this review is to marshal evidence from a diverse range of relevant primary studies that speak to this method of crime reduction. To this aim, in generating search terms for our review, we first broke down the main review question into its constituent parts. Thus, *a systematic review of access control as a method to reduce crime in physical environments* was divided into four key concepts: 1) access control, 2) reduce, 3) crime and 4) physical environments. Synonyms for each of these four concepts were then generated. Next, a list of search terms that speaks to the original four concepts and the synonyms were produced. Moreover, a fifth search cluster specifically related to realist evaluation was included. Consistent with recommended search strategies: 1) truncation symbols will be used throughout to detect variation in wording (*i.e.* prevent* = prevent, prevents, preventive, preventative, prevention, etc), 2) Boolean search terms will be used to combine search strings, and 3) proximity operators will be employed to refine the search syntax.

Access control

These search terms refer to access control as a method to reduce crime.

“Access control” OR access near2 restrict* OR crime near2 prevention OR gating OR alley?gat* OR barrier OR “defensible space” OR territoria* OR guardian* OR entrances OR lockouts OR access near2 block* OR smartcard* OR password OR “card read*” OR “access code*” OR sentries OR locks OR “electronic secur*” OR keypad* OR alarm* OR tamper?proof* OR doormen OR “information security” OR grilles OR bars OR “authorized access” OR authentic* OR “Secured By Design” OR SBD OR “Crime Prevention Through Environmental Design” OR CPTED OR surveil* OR situational near5 “crime prevention” OR SCP or situation* OR control*

Reduce

These search terms refer to what is expected to happen following the implementation of an access-restricting intervention, and the methods through which such outcomes are assessed.

Assessment OR evaluat* OR outcome OR impact* OR “randomised control trial”
OR rct OR “quasi?exper*” OR reduc* OR prevent* OR trial OR test OR
evidence* OR “regression discontinuity” OR “interrupted time series”.

Crime

Consistent with the review protocol in Work Package 1 (Bowers *et al.* 2014), our list of crime types that access control methods might reasonably be expected to address is taken from the list of criminal offences in England and Wales as outlined by the Ministry of Justice.

Offen* OR Re?offen* OR Crim* OR Robber* OR Burglar* OR Fraud OR
Forgery OR Counterfeit* OR Theft* OR Violen* OR Domestic NEAR2 violence
OR Sex* NEAR2 offen* OR Incest OR Prostitut* OR Rape OR Terrori*OR
Homicide* OR Murder OR Manslaughter OR Infanticide OR Blackmail OR
Kidnapping OR Abduction OR “Money Laundering” OR Public NEAR2 disorder
OR Aggressi* OR Riot* OR Shoplift* OR (Drink OR Drunk OR Dangerous)
NEAR2 driv* OR Vandalism OR Delinquin* OR Law NEAR2 breaking OR
“Anti?social behavio*” OR Arson* OR Assault* OR Wounding OR “Bodily
Harm” OR Unlawful OR Disorder* OR Recidivis* OR Reconvict* OR Arrest*
OR Convict* OR Incarcerat* OR Knife? NEAR2 Crim* OR Weapon* OR
Shoot* OR Firearm* OR Explosi* OR Drug* OR Calls for service.

Physical environments

These search terms refer to the settings in which access control crime reduction methods are implemented.

Civi* OR town* OR metropolitan OR municipal* OR Urban* OR physical* OR
rural* OR public OR environment* OR situation OR car park OR parking lot OR
park

Realist

These search terms refer to the core elements of the realist approach.

Context* Or Implement* OR Process OR Mechanism OR Champion OR Capacity
OR Involve* OR Investment OR setting OR outcome*evidence*

Data extraction and management

As indicated in Figure 1, the first level of screening involves the review team examining the title and abstract of those studies returned following the initial electronic and bibliographic searches. All references will first be uploaded using EPPI 4 reviewer software, a web-based

software program developed by the Social Science Research Unit at the Institute of Education, University of London, to manage and analyse data generated from systematic reviews (<http://eppi.ioe.ac.uk/cms/Default.aspx?alias=eppi.ioe.ac.uk/cms/er4>). Once uploaded, studies that fail to meet the inclusion criteria for the meta-analysis component of our review will be excluded (with rates of attrition duly noted). Excluded studies will be flagged in one of two ways: 1) clearly irrelevant (*i.e.* animal studies, editorials, cyber-related access control measures) or 2) possibly of interest. The latter category refers to those studies that will be revisited in the realist stream of our review (in addition to those included in the meta-analysis stream). This batch of excluded studies possibly of relevance to the realist synthesis is expected to mainly comprise studies whose title and abstract suggest access-control-relevant research but which do not (appear to) report a crime-relevant quantitative outcome measure, focussing instead on, say, implementation or process-related (intermediate) outcome measures. Moreover, it is expected to contain the sort of studies that are less amenable to quantitative (ultimate) outcome measures, such as access control methods designed to reduce terrorist attacks. Should disagreements arise over whether a study should be included or excluded, this will be resolved by discussion between the research team. Inter-rater reliability will also be examined (see page 31).

The next stage involves screening the full text of and extracting data from those studies that meet the inclusion criteria for meta-analysis. Entering the information into EPPI 4, reviewers will record the following information:

1. Study details (title, year, author(s), author affiliation, publication, study location(s))
2. Nature (type) of access-control intervention(s) put in place
3. Dosage (intensity) of intervention
4. Type(s) of crime(s) examined
5. Unit of analysis (people, places, etc)
6. Research design (RCT, quasi-experimental, pre-post test)
7. Description of comparison group, place or period
8. Sample (size and any notable features)
9. Statistical test(s) used
10. Outcome measure of interest and data source (police recorded crime data, victim survey data)

11. Effect sizes (where applicable and/or reported) will initially be coded as they are reported (but see below)
12. Other interventions implemented over the study period
13. Indirect effects (displacement and/or diffusion of crime control benefits)
14. Financial costs and benefits
15. Conclusions of the author(s)

The above list details the information that will be extracted from those studies that meet the inclusion criteria for meta-analysis. In addition, reviewers working as part of the realist stream will screen the full text of gleaned studies and extract information related to the topics below, again using an appropriate coding framework in EPPI 4. Reviewers in the realist strand of our review will record information pertaining to the following points. As already described, absence of such information will also be logged.

1. Causal mechanism(s) judged to be responsible for the sought-after (observed) outcomes
2. Context of intervention: nature and description of the setting in which the access control measure was implemented. This can be considered from several perspectives. In one sense context might refer to the broad category of physical environment such as retail, residential, transport system, etc. In another sense, context might refer to characteristics of the specific setting under study, such as a high crime neighbourhood characterised by an enduring distrust in the police or an affluent, suburban village. Contextual factors associated with differential effectiveness might also relate to time of day or season. We expect to code this sort of information in a free-text format with emerging categories being developed over time.
3. The process of and conditions under which the access control measure was implemented, as well as the different stakeholders involved in their individual roles and responsibilities.
4. Intermediate outcome measures that might help to understand the mechanism(s) through which an interventions brings about its effects.

6. STATISTICAL PROCEDURES FOR META-ANALYSIS

We expect studies to differ in methodological approach. Some will have simple post assessments, some pre and post assessments, and some pre and post assessments with at least one control area. We predict that fewer still will have established some equivalency between comparison and treatment areas or will have used random assignment to minimize bias. For completeness, those studies that employ research designs that limit confident determinations of impact will be examined *prima facie* for their presence, but they will not be the focus of the meta-analysis.

To account for the varying levels of methodological rigor, studies will be grouped according to a hierarchy of evidence (most likely quasi-experimental designs versus RCTs) – which reflects the extent to which causal inferences will be sensible – and analyzed separately. Estimates of Effect Size (ES) will be computed within groups and comparisons made between them (see below). The statistical element of the quantitative review will focus on studies which at least meet the following conditions: i) they presented raw crime counts or rates of crime, or reported a standard measure of effect size and sampling variance that is suitable for inclusion in meta-analysis; and ii) the research design used in the evaluation comprised at least two areas: a treatment and a control. These may use random or non-random assignment to conditions (treatment and control), although very few are expected to have used randomization in the design. Where this is the case, however, we will further assess these according to the Cochrane risk of bias tool (Higgins and Green, 2011).

It is expected that a range of different data and methods will be used across primary studies. Some of the issues anticipated will be the use of multiple treatment and control areas; the availability of time series data; the use of crime counts and crime incident rates; the use of different methods for calculating effect sizes; and the computation of effect sizes for different crime types and differences in the handling of intervention effect sizes. These differences will be identified during the coding stage and dealt with in the statistical analysis (see below).

Calculating effect sizes

To estimate the effectiveness of access control interventions overall and for relevant sub-groups of studies, we will undertake a statistical meta-analysis. To enable synthesis, the

individual effect sizes – which may be reported using different test statistics (*e.g.* odds ratios, mean difference scores, and so on) – will be converted to a common metric. To do this, we will standardise by converting to the type of effect size that is most frequently used across the primary evaluations. From our knowledge of the literature, it is likely that this will be in the form of an odds or risk ratio. In other cases, we may find that outcomes are reported as F-ratios or as standardised differences in means statistics. Where possible, if the original authors have not calculated an effect size, but it is apparent that this would be possible using the available data, we will endeavour to calculate an effect size.

Having converted the effect sizes to a common metric, we will undertake a statistical meta-analysis. In line with contemporary research, to deal with any heterogeneity in the effect sizes, we will compute a mean effect size using a random effects model. As is standard practice, when combining effect sizes to compute an overall mean effect, we will weight the individual metrics using inverse variance weights. This will ensure that more reliable effect sizes are given more weight in the calculations. Along with the overall mean effect size, individual effect sizes will be presented, most likely using forest plots showing point estimates and the associated confidence intervals.

Dealing with dependency

It is likely that there will be cases where it is possible to generate more than one effect size from a single primary study. Reasons for this will vary and we could therefore deal with them according to the particular situation, as follows:

1. Data are presented for multiple treatment sites, each with independent matched controls. Where this occurs we will take the mean of the available effect sizes and use this as the overall outcome for the primary study.
2. Treatment sites are compared to more than one control site. In this case, one option is to compute two effect size measures for the study, one showing the worst case scenario and one showing the best. The overall mean effect size (computed across sites) could then be computed using data to show: a) the best case scenarios; and, b) the worst case scenarios. Forest plots summarising the effect sizes will be produced for each scenario.

3. Reductions in crime in treatment sites compared to control sites using different pre and post time periods. We will deal with this as in (2) above.

One issue with these approaches is that data are lost or averaged. Therefore, we will also implement a relatively new procedure, which takes a permutation approach (see Moore and McCabe, 2006; Bowers *et al.* 2011; Johnson *et al.*, 2012). The aim of this approach is to use (most or) all of the available data and summarise the distribution for all possible scenarios (not just the best and worst). To do this, where the number of possible permutations is manageable, an overall mean effect size will be computed for each one. Where there is a very large number of possible permutations, a random sample will be selected using Monte Carlo simulation. This procedure will produce a distribution of standardised mean effect sizes and hence a more complete understanding of the likely overall impact of intervention.

Heterogeneity and sub group analysis

As noted, we expect the effect sizes to vary across studies. To quantify the degree of heterogeneity observed, we will calculate a Q statistic. This statistic is used to determine if any observed variation in effect sizes is likely to be above and beyond that which would be expected on the basis of sampling error alone (see Lipsey and Wilson, 2001). A statistically significant Q statistic therefore implies that there are systematic variations in effect sizes that cannot be explained by sampling error. Such differences would include, for example, variation in the contexts in which an intervention has been implemented.

If, as expected, significant heterogeneity is observed in the effect sizes, a moderator analysis will be conducted to see if variation in factors associated with the reviewed studies can explain this. As alluded to previously, some of the factors considered will be informed by our realist review of the available evidence, with the aim of ensuring that the analysis is theoretically informed. These are likely to include:

- Particular type of access control intervention (*e.g.* locks and bolts, alleygates, barriers)
- Type of context (*e.g.* car parks, housing estates)
- Type of causal mechanism (*e.g.* increase effort, increase risk)
- Date of study – in the case of access control, technological developments (in particular) may lead to improvements in effectiveness.

In addition, we will conduct analyses to see if systematic differences in effect sizes are observed according to:

- The type of study design (*e.g.* RCT versus quasi-experimental)
- The size of study (this might reflect the geographical scale of intervention, the number of treatments applied, or the overall cost of intervention)

As part of the moderator analysis, weighted mean effect sizes will be computed for each of the identified sub-groups. We will also calculate a Q statistic for each subgroup. In the event that the theoretically informed moderator variables explain the observed variation in effect sizes, any remaining variation will be explained by sampling error alone, and the analysis will thus provide insight into (at least some of) the ingredients necessary for successful intervention.

Publication bias

A well-documented issue that can compromise the reliability of the outcome of any meta-analysis is publication bias (*e.g.* Kicinski, 2014). Simply put, if evaluations that suggest positive outcomes of interventions are more likely to be published, there is a risk that any positive effect of intervention will be exaggerated. To determine the extent of a publication bias in our sample of studies, using a moderator analysis, we will first compare the mean effect size observed in published studies with that for unpublished studies. Next, we will produce a funnel plot, plotting the effect sizes against their standard error. In the event that there is no publication bias, the individual effect sizes should be more or less symmetric around the overall mean. If, however, there is an over-representation of studies that suggest an effect greater than the overall mean effect, this would suggest that publication bias is a distinct possibility. In this event, we will use the trim and fill method proposed by Duval and Tweedie (2000) to estimate the true effect size of intervention.

Outlier analysis

Outlying individual outcomes can distort the overall mean effect size estimate. Such outliers are particularly serious if they have extreme values and/or come from large studies that have

been heavily weighted in the meta-analysis. The analysis will check for the existence, and where appropriate, the influence of such outliers. This will be done by visually assessing the presence of any extreme values from the forest plots. If it is apparent that potentially problematic outliers exist, mean effect sizes will be calculated both with and without the inclusion of the extreme value. This sensitivity analysis will establish whether mean effect sizes in such situations are robust and consistent or whether the outlier has a problematic influence over the results found.

Inter-rater reliability

This looks at the reliability of the data extraction process. Checks will be made to assess whether the subjectivity of the coding process has an influence over the information (particularly that relating to outcome) that is extracted. For at least a random sample of studies, two coders will independently code the outcome measures and other findings. These will be compared and the level of agreement will be calculated. If at any stage of the process, or for any category inter-rater reliability is low, measures will be put in place to resolve any differences.

7. TIMEFRAME

Stage	Estimated time period
Searches for published and unpublished Studies	April-May 2014
Screening articles based on inclusion criteria	May – June 2014
Coding of eligible studies	June – September 2014
Statistical analysis/realist synthesis	September - November 2014
Integration and presentation of results	December 2014
Preparation of final report	February 2015

8. PLANS FOR UPDATING THE REVIEW

The authors expect to update the review every five years.

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APPENDIX

Examples of key publications relevant to access control in physical environments are:

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