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Getting closer to the action: Using the Virtual Enactment Method to understand burglary

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### **Abstract**

In this paper we describe a new method, the Virtual Enactment Method (VEM), to enhance offender recall and motivation to disclose information by having burglars reflect on their experience while committing a crime in a simulated virtual environment. Participants, a sample of 61 incarcerated burglars, 'thought aloud' whilst undertaking a virtual burglary. Following the 'virtual' burglary, emerging themes were expanded upon in an interview. We show that the simulated environment effectively reinstates the criminogenic event, increases engagement, enhances recall, and encourages participants to talk more openly about their experiences, skills and knowledge.

**Keywords:** Burglary, virtual reality, expertise, substance misuse, crime prevention

“It was just like being back on the road”

(Incarcerated burglar reflecting on his experience of undertaking a ‘virtual’ burglary).

Residential burglary is a prevalent crime, with 2.9 million incidents per year in the United States (Truman & Langton, 2015) and over 700,000 incidents per year in the United Kingdom (Crime Survey for England and Wales, 2016). Alongside the financial cost to the victim, it often has a considerable emotional impact. Ceccato (2016) and Warr (2000) indicated that it is often considered to be one of the most feared crimes because it is perceived as more likely to happen than physical assault. Similarly, Kershaw et al. (2000) analyzed British Crime Survey data and noted that 87% of victims considered themselves to be affected emotionally, 29% very much so. Alongside this, the low clearance rates of 13% in the United States (Federal Bureau of Investigation, 2009) and 17% in England and Wales (Smith, Taylor & Elkin, 2013) demonstrate the importance of further investigation into the crime itself, and into the motivations, decision-making and skills of the perpetrators of the crime. This can be used to inform and improve situational crime prevention and target hardening, and so to increase the apprehension rates of offenders.

The aim of this article is to demonstrate how the use of a simulated environment can allow for ‘observing’ and recording offending behavior as it happens, and can also provide researchers with a means to elicit valuable offender insights into criminal behavior, cognitions and emotions. We describe the use of a new method, the Virtual Enactment Method (VEM), that involves combining the visual methods (i.e. virtual reality), ‘think aloud’ techniques, and interview methods, to accurately record offender cognition, emotion and navigation, and to observe offending behavior in an ethical manner. We show that the VEM has the additional benefit of eliciting more uncontrolled, valid and detailed responses as participants’ engagement in the task is increased. This can result in far greater levels of disclosure and spontaneous verbalizations than experienced by

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traditional interviews alone. Once involved in the 'virtual burglary', we show that even some of the most reluctant participants became more vocal and volunteered details regarding their behavior and experiences as they responded to the environment. This benefit is a valuable addition to the toolkit of the researcher, in exploring the reasons behind participants' choices and decision-making during the event, and in allowing the identification of themes important to the experienced offenders themselves. These themes can then be expanded in interview. Additionally, we propose the relevance of these themes will be greater than with the use of still photographs (as has been common in ethnographic and sociological research and will be discussed below), as the participant will be closer to experiencing the memories and emotions of participating in a real-life burglary. As Ericsson and Simon (1993) noted, nothing improves the validity of verbal data more than the elicitation of non-reactive verbal reports while completing a task. The need for questioning by the interviewer is reduced, as participants respond to, and to a certain extent, control the visual stimuli. In the research described in this article, the potential of this method as a means to shape interviews in order to gain the most valid and rich offender based accounts is tested.

Below, we will provide a brief overview of what is known about burglary behavior and cognitions from previous research; discuss the methods we used in this research; outline briefly the quantitative findings of the study and describe in greater depth its qualitative aspects; and identify the value of this new visual methodology, which we call the 'Virtual Enactment Method' (VEM) in increasing our knowledge of offending behavior.

### **Decision-making in residential burglars**

Research into residential burglary over the past few decades has provided detailed knowledge of the types of properties targeted (Nee & Meenaghan, 2006; Nee & Taylor, 2000; Shover, 1973; Waller & Okihiro, 1979), the types of goods stolen (Clare, 2011; Bureau of Justice Statistics, 2013; Crime Survey for England and Wales, 2013), target hardening and community crime prevention (Bennett & Wright, 1984; Cromwell, Olson & Avery, 1991; Bernasco & Nieuwbeerta,

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2005; ) and more recently, decision-making and expertise in residential burglary (Garcia-Retamero & Dhami, 2009; Nee & Meenaghan, 2006; Nee, 2015; Nee et al, 2015; ). Early work with experienced burglars demonstrated that burglary is rarely an impulsive, indiscriminate act (Nee, 2015), and that an understanding of environmental factors and the motivations and cognitions of experienced burglars is important to build up a full picture of the burglary event. It is, for example, common for burglars to make the initial decision to commit the burglary away from the scene of the crime, sometime before target choice (Nee, 2015). In an early study, Shover (1973) interviewed experienced burglars, and identified the 'good burglar' – one who specializes in burglary, and who demonstrates technical skill and success. These individuals described driving for sometimes hundreds of miles on 'scouting-trips', looking for areas and properties similar to those they had targeted in the past. Subsequent research suggests that scouting for suitable targets more commonly occurs in neighborhoods closer to home, as the offenders go about their daily routines (see, for example, Wright and Decker, 1994). Bennett and Wright (1984) too found that around half of their sample of experienced burglars travelled to an area believed to be attractive for burglary from their previous experience, and made their target choice at the scene of the crime using environmental cues indicating property vulnerability. They called these burglars 'searchers'. In addition to these, a further 17% would use the same environmental cues as the 'searchers' to identify vulnerable properties during their daily routine, and return later to commit the burglary. Nee and Taylor conducted three studies looking further into the skills and knowledge possessed by burglars. They concluded that three quarters of their sample were 'searchers', making the decision to burgle away from the scene of the crime, with smaller numbers demonstrating either a less experienced, opportunistic approach, or a more skilled, planned approach (Nee & Taylor, 1988; Nee & Taylor, 2000; Taylor & Nee, 1988), a finding also reported by Nee and Meenaghan (2006).

Many burglars claim to avoid committing crimes on their own doorstep, instead choosing more lucrative properties outside their own immediate neighborhood; however, we know this not to be true. Crime statistics show high levels of burglary among social housing (Crime Survey of England

and Wales, 2013), perhaps due to the immediacy of need for reward or access to transportation. In addition, the literature on expertise and environmental criminology highlights the importance of familiarity in building rich schemas upon which to base burglary decisions, increasing the attractiveness of houses within the burglar's locale or 'awareness space' (Brantingham & Brantingham, 1991, 2004).

### **Burglar expertise**

More recent work utilizing knowledge from cognitive psychology demonstrates how instantaneous recognition of cues in the environment results in effective and relatively automatic decision-making (Nee, 2015). As such, experienced burglars can be compared in their decision-making and cognitive processes to 'experts' in other fields (Nee & Meenaghan, 2006). Nee and Ward (2015) brought together research in criminal expertise to develop their model of 'dysfunctional expertise' to understand offender decision-making at the scene of the crime. This model proposes four stages of decision-making, (1) automatic and unintentional appraisal of the environment; (2) superior, automatic recognition of offence related cues; (3) as a result of practice, the activation of complex cognitive schema, which guide (4) rapid responses to environmental cues, through the playing out of behavioral scripts. Nee and Taylor (1988, 2000) showed how, in comparison to 'novice' householders (i.e. with no burglary experience), burglars use fewer, more systematic routes to identify access around potential targets, and process cues indicating wealth and access more quickly. Characteristics of a property assessed in target selection (importantly, relative to others in the locale) include size, decor, visible items of value, vehicles on the driveway, access, cover (e.g. vegetation), fences, visibility from neighboring properties, occupancy, doors and windows that are harder to access, and level of security (Bennett & Wright, 1984; Bernasco & Luykx, 2003; Bernasco & Nieuwebeerta, 2005; Brantingham & Brantingham, 1975; Coupe & Blake, 2006; Garcia-Retamero & Dhimi, 2009; Maguire & Bennett, 1982; Snook, Dhimi & Kavanagh, 2011). A combination of such cues are processed significantly more quickly than novice comparison groups, and the importance of

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each cue may change over time, for example in daylight versus night time (Nee & Taylor, 2000).

Once inside the property, the search is also characterized by a reliance on cognitive scripts based on past experiences. Experienced burglars take systematic routes based on previous burglaries, spending more time in high value areas, identifying more high value items, allowing for an efficient, fast and lucrative search, maximizing reward and minimizing risk (Clare, 2001; Nee & Meenaghan, 2006; Nee et al., 2015; Wright & Decker, 1994).

These findings provide support for idea of the burglar as an expert in his field, and for Nee and Ward's (2015) model of dysfunctional expertise to explain the decision-making of the offender at the scene of the crime. However, much of the research to date has important limitations. Ethical and logistical issues make it difficult to observe actual offending behavior, and as such the earlier offender based work relied on interview methodologies. Whilst valuable, such methods rely on the interviewees' memory and reporting of the event, and inaccuracies may occur intentionally (e.g. exaggerating or minimizing actions (Elffers, 2010; Kearns & Fincham, 2005) or unintentionally (e.g. forgetting, reversing the sequence of events, time distortion, Bradburn, Rips & Shevell, 1987; Nisbett & Wilson, 1977). Van Gelder et al. (2016) note that even when research is conducted 'in the field' (e.g. at the scene of a recent burglary), much of the decision-making that occurs during the actual commission of the crime happens automatically and unconsciously. It is therefore not subject to deliberate retrieval from memory. They propose the use of virtual reality as a means to not only enable the study of offending behavior as it unfolds, but also allow for the greater understanding of the criminal decision-making process as a result of the increased level of realism and the potential for the researcher to exert control over the research environment. In addition, given the importance of the complex processing of a wide range of changing environmental cues in decision-making, the possibility of recreating the burglary event should increase our understanding of behavior at the scene of the crime in important ways. In the current investigation, we focus on residential burglary, to demonstrate the potential of the Virtual Enactment Method (VEM) in furthering our understanding of decision-making and offender expertise in a range of criminal activities.

### **The use of visual methods to improve accuracy and recall**

The use of 'photo elicitation', that is the addition of photographs to a research interview, has been common in sociological research, and is considered to not only provide more information, but also different information to that gained through interviews alone (Harper, 2002). The use of elicitation techniques are particularly useful in encouraging people to share details of experiences that are hard to talk about (for example, where social, cultural or psychological barriers may exist, or in the investigation of 'automatic', unconscious behaviors that participants find hard to describe through lack of awareness (Barton, 2015). Both of these barriers may apply in discussions with offenders when asked to describe unethical offending behavior that has become automatic through the development of 'dysfunctional' expertise (Nee & Ward, 2015). Early proponents of the use of photographic stimuli noted that 'photographs elicited longer and more comprehensive interviews, but at the same time helped subjects overcome the fatigue and repetition of conventional interviews' (Collier, 1957: 858). Significant objects (keepsakes, trophies etc.) have also been shown to trigger events, and help people place memories of events into historical context (El Guindi, 2000). Ethnographic researchers at times make use of 'walking probes', where participants and researchers visit a particular location and discuss the significance of the environment and associated experiences. According to De Leon and Cohen (2005), this technique is successful in eliciting detailed information regarding history and personal information.

Chiozzi (1989) and El Guindi (1998) reported anecdotal evidence of increased disclosure of detail in interviews after incorporating still visual images, and in addition, increased involvement in and enthusiasm for the interview process. Participants no longer act as 'subjects', but take on a more active role, exerting greater agency in the research (Harper, 1988). Similarly, Collier and Collier (1986) and Morrow (1998) noted the potential of photographic stimuli in serving as ice-breakers, and speeding up the process of building rapport between the participant and researcher. We think

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that the use of visual stimuli has important implications for the study of offending behavior, as participants may be reluctant to share details of their unethical behavior with researchers, particularly in a criminal justice setting such as a prison. Used alongside the 'think aloud' process (Ericsson & Simon, 1993) we demonstrate its ability to significantly enhance both memory and motivation to disclose cognitions, emotions and behavior surrounding the crime.

## **Integrating concurrent and retrospective reporting through virtual reality**

We propose that the use of virtual reality can further enhance these elicitation effects and potentially with greater impact than previous methods such as photo elicitation as it can effectively reinstate the criminogenic event. That is, the potential of still images to increase engagement is enhanced by immersing participants into a virtual criminogenic environment, enabling us not only to 'observe' potential offending behavior as it happens, but also improving the detail and accuracy of verbal reporting as the 'crime' unfolds. This allows for the use of some of the techniques of protocol analysis (Ericsson & Simon, 1993) to uncover thought and decision processes during the actual completion of a 'burglary' that have become automatic through the development of expertise.

The strength of the Virtual Enactment Method described below lies in the fact that it enables both concurrent (think aloud) and retrospective (interview) reporting, allowing for a detailed examination of observed and described behavior. This method may also address the problem of reduced accuracy of retrospective reporting due to the time lag between an event and the reporting about it that is inherent in interviewing research. Allowing participants to think aloud while performing the behavior of interest, e.g., a burglary, and interviewing them about utterances immediately afterwards should result in responses that relate to the recent memory of this 'offense'. Provided the simulated event is similar enough to its real life counterpart to produce accurate behavior and decision-making, this will reduce the tendency for participants to make judgements in their answers based on speculation and reliance on long-term memory (Nisbett & Wilson, 1977; Ericsson & Simon, 1993).

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In the field of burglary research, several studies have presented visual stimuli during interviews. Bennett and Wright (1984), for example, supplemented interviews with videos and photos. This gave a more detailed understanding of how burglars used the visual cues identified in previous interview studies to make decisions at the scene of the crime. Nee and Taylor (1988) built on this work by comparing burglars with novices (householders) using maps and slides alongside interviews. They were able to identify the complex nature of the interaction of these environmental cues. Wright and Decker (1994) improved the ecological validity of the stimuli by interviewing active offenders at the scene of a recent burglary. This valuable ethnographic research, with its groundbreaking use of rich visual cues, has yielded valuable insights in terms of providing explanations of offender decision making, the motivations behind burglary, and the actual commission of the offence. However, these studies necessarily relied on retrospective methods and therefore were prone to some of the same memory limitations of previous interview work, albeit in a less extensive way (Nee, 2010; Van Gelder et al., 2016).

In this article we argue that recent technological advances can increase the benefits observed through the use of photo elicitation and similar visual techniques, while overcoming their most important limitations. By using a realistic virtual environment that serves as a substitute for the real world, participants are able to interact with the environment and to assess and respond to cues as they encounter them in the virtual neighborhood. In other words, this allows researchers to observe crime *as it unfolds*, yet in an ethical manner (Nee, 2010).

### **The use of the Virtual Enactment Method – benefits over less immersive techniques**

The current research builds on recent work of Nee et al. (2015), in which participants ('expert' ex-burglars and 'novice' students) undertook a 'mock' burglary in both a real house and in a simulated house on a laptop. Even though the sample size was small, the simulation was successful in (a) identifying expertise in the behavior of burglars compared to novices, and (b) demonstrating that almost identical behavior was observed in the burglary of the real house and the simulated

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property, indicating that the behavior of participants in a simulated environment may indeed be comparable to that of real life. This comparability of behavior in real and virtual environments has also been demonstrated in other settings, such as Slater et al.'s (2006) virtual re-creation of Milgram's (1963) obedience study in which participants reacted in a similar way behaviorally and physiologically when administering 'virtual' electric shocks to a virtual stranger as did Milgram's 'real-life' participants – their reactions showed they were treating the 'virtual' person as if they were real. Slater et al. (2013) also successfully recreated Darley et al.'s (1968) bystander effect experiment, by creating a 'virtual' confrontation in a 'virtual' bar, demonstrating that as in real life, participants intervened more frequently when the victim was part of their in-group (a supporter of the same football team, in this case) than for out-group members. This again demonstrated the potential of virtual reality to investigate ethically problematic situations, and extended the benefits of those found using photo elicitation techniques.

The Virtual Enactment Method is the next step in the development of the visual elicitation techniques described previously, and shows how the benefits of their use can be advanced by the use of a rich, interactive environment. The overall aim of the 'Virtual Burglary Project'<sup>1</sup> is to demonstrate the potential of virtual reality to study burglary and other crimes. By interacting with and responding to cues in the environment, offender decision-making can be more accurately and reliably 'observed' and recorded. For example, routes taken inside and around the property, time spent in specific areas of the house, and the exact items stolen (including their value and weight) can be logged and analyzed alongside the free-responses of offenders as they navigate the environment. This detail allows for an intricate understanding of offender decision-making processes. The often automatic nature of the decision-making process means that offenders may not be fully aware of their offence related behavior, and so verbal reports using interview alone may not be fully or entirely accurate.

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<sup>1</sup> The Virtual Burglary Project is an ongoing collaboration between the University of Portsmouth, the Netherlands Institute for the study of Crime and Law Enforcement (NSCR) and VU University Amsterdam.

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The use of this immersive technique has the benefits of (i) reducing the influence of researcher questioning, as participants are required to freely respond to contextual cues, and (ii) eliciting more genuine and valid responses, as participants are immersed in the environment rather than relying on their imagination (Van Gelder et al., 2016). It also addresses one of the main challenges of criminology, by allowing us to get far closer to observing real world behavior in an ethical manner, whilst also increasing the motivation of participants to share their experiences, skills and motivations for committing crime and/or burglary (Van Gelder, Luciano & Otte, 2014). Importantly, as reported by Friedrich (2016) virtual reality has the potential to enable effective visualization of an event, resulting in increased emotional engagement. This was clear in the research reported here.

### **The simulated neighborhood**

The virtual burglary simulation was carefully devised using creative technologists and extensive knowledge of residential burglary in members of the research team, to replicate what would be considered a typical residential neighborhood and property type for the majority of experienced burglars to target. From the earlier literature described in the introduction, we know that a combination of environmental cues interact to influence target selection, and so, with these factors in mind, a residential neighborhood was designed consisting of five terraced houses each with external aspects making them more or less attractive to the experienced burglar (access and surveillance cues, such as side or rear access, vegetational cover, proximity and visibility of neighboring houses; security cues such as alarm boxes, blinds open or partially shut; and reward cues such as a bike outside the house, a car parked outside) (Figure 1). Upon 'entering' the simulation, the participant would find themselves standing opposite the row of houses that could be targeted. They could freely 'walk' around in the neighborhood, get up close to the front of the houses, look in the windows, and go down side streets to reach the rear of the property. The back gardens could be accessed via an alleyway, and were fenced off, with gates allowing access to the

properties. This provided the choice of more secluded entry points (most experienced burglars report a preference for entering the property at the rear if possible; Nee & Taylor, 2000; Nee et al, 2015).

Insert figure 1 about here

Once a property had been selected, participants could enter through the front door, the back door, or an upstairs window (reached by climbing the drainpipe). The interior of the property was designed to reflect a typical house in terms of layout and content (the layout and lootable items in all the accessible properties was identical to allow for a comparison of routes, time taken in the property, and items stolen regardless of which property they selected) (Figure 2). The ground floor consisted of a living room, dining room, kitchen and bathroom, with a hallway and staircase leading to the first floor. This was made up of the master bedroom (including the open window which could be accessed from the back garden), a children's bedroom, a study and the main bathroom. There was also an airing cupboard, and stairs leading to the second floor, where the teenage bedroom and games room were located. All rooms contained items that could be stolen, and furniture such as cupboards and drawers that could be opened and 'searched'. Previous research suggests that the most popular items targeted are money, jewelry and electrical goods – small items that can easily be transported and fenced (Clare, 2011). We included the larger electrical items to increase the realism of the property, to create a discussion point as to why they may or may not have stolen such items, to encourage discourse on methods of fencing and disposal, and to compare the approach of the experienced burglars with that of the control groups.

Insert figure 2 about here

## **Method**

### **Participants**

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Participants in this study were 61 male incarcerated offenders (age range 20-56,  $M = 37$ ) with high levels of burglary experience serving prison sentences for various offences (not just burglary). Four UK prisons were used to recruit this sample. Participants were recruited through leafletting prison wings, self-referral, and through the recommendations of other prisoners and prison officers.<sup>2</sup> Most described their ethnicity as white British or Irish ( $n=45$ , 73%), white European ( $n=1$ ), and the remainder ( $n=15$ , 25%) were black British, mixed British or black Caribbean. Involvement in burglary began at an early age for most participants – half were under 16 at the time of their first offence.

Previous conviction data and self-reported offending history revealed involvement in burglary over a long period. Forty-five participants (74%) described involvement as either: ‘over their lifetime’; for more than 10 years; or in terms of multiple burglaries per day or week for an extended period, and they were often involved in other acquisitive crimes alongside burglary, most usually other theft related offences such as car theft, robbery and commercial burglary. Drug offences were also common, with many participants directly relating their drug use to their involvement in burglary.

### **Materials**

The virtual neighborhood was presented on a laptop computer, and could be navigated using a gamepad or a mouse. To increase the level of immersiveness of the simulation, participants wore headphones through which naturalistic environmental sounds could be heard (birds singing, cars driving past, airplanes overhead), and also sounds relating to user actions (doors opening). Participants pressed a button on the gamepad to open doors, cupboards and drawers, and to pick up items. They also had the option to drop items picked up in error, and to crouch.

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<sup>2</sup> As we were also recruiting a comparison group of prisoners without burglary experience, we ran 116 participants in total and the 61 we report on here were those with high levels of burglary experience. We also included a non-offender control group (community-based), and these two control groups were matched on age, ethnicity and socio-economic background.

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A digital voice recorder was used throughout the procedure, to record participants' verbalizations during the completion of the simulation, and their responses in the subsequent interview.

### **Procedure**

Data collection took place in a private office or room on the prison wing or education department, with just the researcher and participant present. After fully briefing potential participants, acquiring consent, and completing a brief demographic questionnaire, participants were briefed as to how to navigate the virtual environment, and were asked to complete the 'burglary' as if it were a real-life experience. They were encouraged to 'think aloud' if they wished while completing the task, and as well as audio-recording their verbalizations, the researcher noted down issues to be further explored in the subsequent semi-structured interview. The original aim of this post-simulation interview was to ascertain whether or not the participant should be allocated to the 'experienced burglar' group or the control group. That is, we wanted to explore their level of experience in burglary and other crimes (though in effect, this became obvious during the 'mock burglary'). It also aimed to explore in a semi-structured way the participants' experience of undertaking the mock burglary, including their well-being afterwards, their views on whether the virtual reality neighborhood could be used as a research tool (which speaks to the validity of the method), and what they thought the strengths and weaknesses of the simulation were. However, the interview was sufficiently open-ended to allow for the investigation of additional themes identified by the burglars as they 'thought aloud' whilst navigating the virtual environment. The entire process, from briefing to debriefing, took between 30 minutes to an hour, depending on the length of time taken to complete the burglary, and the depth of the subsequent interview.

During the process of data collection, it quickly became apparent that the undertaking of the mock burglary served to build rapport between the researcher and the participants. It made participants notably more willing to talk about their skills, experiences and knowledge as they

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became more immersed and engaged in the task, as also reported in the photo elicitation studies described above. We were encouraged to find that benefits found in the use of evocative images and salient objects in terms of increased engagement of participants could be replicated by the use of our method, despite the fact that computer generated images rather than personal images were used. Participants who were initially suspicious and reluctant to talk noticeably relaxed and unexpectedly mentioned a wide variety of issues as they 'burgled' the house, which were then explored in the subsequent interview.

Some of those themes emerged in response to lootable items that had been placed around the property, prompting explanations from participants as to why they chose to steal (or leave) them. Examples include car keys and certain items of technological equipment. Participants also explained their behavior and decision-making as they navigated the environment, allowing the subsequent discussion of motivations and factors influencing their behavior. We grouped the themes that emerged below into issues associated with:

- Approaches to undertaking the burglary (including target selection, levels of forensic awareness, recent changes in residential burglary and abandoning a burglary)
- Substance misuse and how it impacted the development of the criminal career, and its relationship with offending expertise
- Behavior and emotions of experienced burglars in the time immediately after the commission of a residential burglary
- The experience of undertaking the 'mock burglary' (including improvements to the simulation to make it more realistic, more relevant and more effective as a proxy for real life burglary behavior).

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The data recorded by the computer program was analyzed and compared to control groups. These control groups enabled us to assess differences in the time spent in different areas of the simulation, distance travelled, routes taken, and value and weight of goods stolen. These data were subject to a range of quantitative analyses including multivariate analysis of variance (MANOVA), t-tests and chi-squared tests, and the findings are reported elsewhere (Nee, Van Gelder, Otte, Vernham & Meenaghan, under review).

### **Results and discussion**

Upon entering the virtual environment, most participants first engaged in some level of 'scoping'. This usually involved 'walking' along the pavement in front of the properties and looking in the front windows to ascertain which property had the most potential gain. As they did this, many participants noted cues to wealth and security, for example, highlighting the presence of an expensive bicycle outside one property, or an alarm box on another. The front window of each property was designed to look slightly different (blinds open/shut/partially open, and a different item placed in each window, visible from the street). Once up close, it was possible to see the interior layout and content of the property through the window (similarly, through the rear patio doors). As they walked round the neighborhood, many participants, without prompting, explained their choice of property and access point. Such vocalizations continued throughout the commission of the 'burglary', and allowed the researchers to identify indicators of expertise that could be discussed further in interview. As noted previously, even participants who showed initial reluctance, and were not forthcoming with information at the start of the experimental session were surprisingly and increasingly vocal as they became engrossed in the burglary task, providing an explanation for the decisions being made as they navigated the property and adding to the understanding of their behavior in and around the property.

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Having performed some level of investigation of the neighborhood, participants selected a property to 'break into'. Doors could be opened using the game pad, and participants were then free to explore the house, and 'steal' as many items as they wished (participants were asked to treat the burglary as if it were real life, and to spend the amount of time they usually would in a real burglary). To add to the level of realism, the more items picked up (and the heavier and bulkier the items selected), the slower the movements of participants would become in the virtual environment. Participants had the option to place looted objects in a 'dropzone' by the front door, and to continue the burglary, these items would 'go with them' when they left, and the speed of participant movements would return to normal.

### **Approaches to undertaking the burglary**

In addition to commenting on the type, affluence and vulnerability of the properties as they walked around the neighborhood, participants often indicated the likelihood that they themselves would target such houses as those presented in the simulation. As burglars scoped the virtual neighborhood, they commented on how far they tended to travel to find targets in real life.

'Personally I would go out of my own area, then you don't have to hide all the time, get on with your daily life' (participant 49).

'well you're not as well known in other areas. Because they get a profile on you, a police profile. If you're a known burglar and you go to the same area they're bound to catch up with you aren't they?' (participant 51).

'If you do it in your local area, if you get caught everyone is going to know it's you, your family and that, you've got to walk round the street and everything.' (participant 87).

In line with decades of previous research (e.g. Bennett & Wright, 1984; Nee & Taylor, 2000) very few participants mentioned immediately capitalizing on a lucrative opportunity, or on the other extreme, planning burglaries to any great degree in their real life burglary activities. This information

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was often volunteered by participants as they attempted to gain access to the property, which could be achieved by simply pressing 'x' on the gamepad. The unrealistic nature of this prompted many to disclose some of their actions before embarking on a burglary (e.g. tools carried, occupancy checks, methods of entering a property). This could then be followed up in the interview, however extending the simulation to include the 'planning' phase in future simulations may be beneficial in increasing knowledge of decisions made prior to the actual burglary. A small number did mention a new tool in planning burglaries, that of social media.

'Facebook too - blasting out whether someone's home or not, to making dummy calls, being able to find out people's details using these social sites to see if they're home, see when they are, you can do a whole profile on someone. And then know whether you want to burgle them, usually what you've posted makes you interested in you wanting to burgle them in the first place' (participant 96).

This is an area worthy of further research, particularly with a younger audience. The use of social media in residential burglary has largely, to date, been reported by the media, the police, security companies, and as a concern of ex-burglars, rather than as a result of research efforts (e.g., Smith, 2013; Prince William County Police Force, 2017; Stirling, 2011). There are a number of social media sites that may allow for the identification of empty properties (householders posting that they are on holiday, for example), or lucrative items (web-based sales sites). Friedland and Sommer (2010) provide a review of not only the potential avenues for offenders to utilize, but also demonstrate the ease and accuracy by which targets can be pinpointed using location-based services on mobile devices, even when the users of such sites believe they are taking sensible precautions to protect themselves. Other web-based technologies, such as Google Street Map and Street View may allow burglars to engage in initial planning without even visiting the site, reducing travel costs, and the risks involved in 'scoping'. Although this may not reflect the current situation (e.g. presence of cars, curtains drawn or open, for example), it provides a useful starting point, and

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may actually increase the awareness space (Brantingham & Brantingham, (1991; 2004) and number of potential targets available to residential burglars (Vandeviver, 2014).\_

The most common, spontaneously cited cues for target selection were those relating to surveillance (the possibility of being seen while entering or being inside the property) and, as expected, more burglars entered the end of terrace houses (n=42, 69%) and at the rear (n = 29, 48%):

'I would look for the house that was not looked on to by other houses, corner houses, ones with back alleys' (participant 94).

'more tree surrounded type places, foliage if you like, things to block off direct views to the house' (participant 75).

'I'd check the first three houses, just so long as there's no people in the first three houses I'll break the window 'cause I know no one can hear it for three houses along' (participant 1)

'no I'd always pick an end house wouldn't pick one in the middle, if it was a terrace it'd always be an end one, most time I'd go in the back... I'd never do one in the middle of a terraced... ' (participant 83)

'Depending on where you are in the neighborhood, and depending on which one's the easiest route and where you're less likely to be seen. I'd say that probably in a neighborhood like that you're more likely to go in the back door' (participant 94)

Relative reward (in comparison to other houses on the street) was the next most frequently mentioned cue to target selection (n=11, 18%), and as the experienced burglars walked around the environment, they pointed out cues as to the affluence of the property compared to the other houses on the street. This commentary provided a useful insight into the interaction of

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environmental cues in target selection, and could be used in future research to contribute further to our understanding of dysfunctional expertise:

'The reason I went for that one is that it had a nice bike out the front and they looked like they had more money than the person with the old granny bike down the end of the street. It's all about appearances see.' (participant 110)

'you've got to look up see what you can see in the house first, especially if you've got five houses that are empty, you got your pick there see, if anything you've got to jump over the garden, quickly mooch up and move on to the next one, that's generally how it works, what you do is you walk round once, see what you can see, [I] walked down the alleyway and you couldn't really see a lot through the back so I had to see what I could see through the front windows, from the outside there was a nicer bike there, outside this, there was a couple of cars but, something like that it's promoting the house, it makes you want to go in and have a look. They've already got a big sign outside the house 'come and rob me'.' (participant 110)

Once the chosen house was entered, burglars stole fewer items with lower weight and volume, but of higher value compared to control groups (who went for bulky items). Jewelry, money and light valuables were among the most popular items to steal, 17 (28%) participants specifically stated only targeting such items:

'I go for light things, anything I can carry and walk out with. I go for jewelry, gold, I wouldn't take no TV'. (participant 57)

This demonstrated the superior recognition for high value, easily transportable and convertible goods by experienced burglars – a clear example of 'dysfunctional expertise' (Nee & Ward, 2015):

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'all Apple items are going to be popular, that's why I just took the Apple... jewelry, preferably the smaller things, like diamonds, jewelry, if you're a house burglar that's what you're going to be looking for, anything that's Apple is going to sell'. (participant 62).

A minority of proficient burglars (n=3, 5%), however, mentioned actively avoiding Apple products as a result of the tracker software incorporated in these. This is perhaps an indicator of the ongoing development of expertise in some participants, as a result of their own experiences and those of others, that goes alongside continuing involvement in burglary and the disposal of goods:

'you couldn't take the phones, the tablets, 'cause they're Apple, they've got trackers, that's the reason why I wasn't taking them' (participant 111).

'don't touch any iPad stuff, I can sell iPhones, I can't sell Apple computers, because they're traceable, very easily traceable, and they take anonymous photos, put the password in twice wrong... and they take a photo of you, without the computer telling you, one minute you're tapping in a number, the next minute it's taken a photo of you'. (participant 118)

Hidden in a box in a filing cabinet in one of the rooms was a passport. Upon finding this, participants tended to automatically talk about whether they would take it or not. It prompted the subsequent discussion of the desirability of identity documents, and over two thirds of participants identified that the popularity of such items had increased in recent years:

'yeah definitely, passports, credit cards...go shopping on their cards, clone the cards put them back' (participant 19).

'oh yeah, that's big money, cause there's a lot of immigrants coming over, they need to stay in the country, to work in the country, if they can come over and it's already there, they don't have to wait...it's a long process, so they can get straight into work' (participant 29).

'yeah, it's good money isn't it. Sell them to illegal immigrants' (participant 51).

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'Yeah 'cause you can do many stuff with them...fraud, it's simple on a laptop' (participant 58).

'credit cards maybe, the amount of people that have their credit card in their wallet then have their pin number in the back of it somewhere too...' (participant 77).

A number of participants asked if they could take the car (parked outside the house), or whether the keys positioned by the front door were for the car, prompting further discussion on the likelihood of taking car keys. Three groups of participants were identified as a result of this, those who would *not* take the car (n=17, 28%):

'I don't mess about with people's cars. I don't see the logic in it really, 'cause with the new cars a lot of them are GPS, they can be tracked' (participant 57).

Those who would use the car to transport a larger number of bulkier goods from the property (n=12, 20%):

'to take stuff away, you need a vehicle to take it away with. If you leave your car keys on the side that's just giving me the opportunity to say take my car - take the bigger and heavier things because they're able to move them out quickly' (participant 37).

'if you're going round to burgle, you've got to take the car keys, as well as stuff, or where are you going to put it. I'd grab the car keys straight away, go and grab what I've gotta grab, then go and take it all out to the car, drive off' (participant 71).

And those who would, as an added bonus if the opportunity presented itself, take the car with the intention of selling it for further profit or for use in further crimes (n=6, 10%):

'Yeah take the car, use them for other crime, get them plated up' (participant 19).

'It's so hard to steal a car now, the only way to get them is with a key. There's a lot more gangs around, buying cars' (participant 85).

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‘taking them at the same time, cause the cars can't get taken unless you've got the keys...selling the cars, replating them and selling them on’ (participant 92).

‘if there's a brand spanking new car on the drive why not leave in their car. Until the burglaries reported stolen the cars not reported stolen’ (participant 117).

Very few participants (n=3, 5%) indicated that targeting a property purely for the car keys (without burgling the rest of the house) was something they might be involved in, suggesting that this may be considered a separate crime from traditional residential burglary:

‘you still have to burgle a house to get the car keys out, so to me if you're gonna open up a letter box and get a front door open to get a set of keys you might as well... [burgle the whole house]’ (participant 1).

Another theme that emerged in relation to actual behavior while committing the burglary was awareness of forensic issues. To our knowledge, this has not been explored in research before. While most participants claimed to be ‘aware’ (n=21, 34%), ‘very aware’ (n=4, 7%), ‘cautious’ (n= 27, 44%) or ‘very cautious’ (n=5, 8%) with regards to the forensic traces they could leave behind, the actual precautions described were relatively rudimentary, and limited to the use of gloves (or covering their hands with coat sleeves), and the disposal of shoes after the event. The contradiction is highlighted by the following participant:

‘very aware. If I touch it I take it. Other than that, I would wear gloves. If I didn't have a pair of gloves on, and I was able to get in the house without leaving my DNA or fingerprints my motto is if I touch it I take it’. (participant 57).

Only six (10%) participants identified the possibility of leaving DNA evidence through sweat, hairs, sneezing and similar, for example:

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'cover your hands, wear tight fitting clothes so you don't lose any fibers or hairs from your clothes, headwear, stop hairs being left behind. Make sure you don't leave any breaths on the window, sweat, blood' (participant 56).

'a lot of burglars also shave their hair off, so it doesn't leave anything behind, doesn't leave any evidence'. (participant77).

Whilst conducting the 'mock' burglary, many participants asked if there would be anyone in the property, or if anyone would come home, and when questioned further overwhelmingly (and in line with previous research, e.g. Nee & Meenaghan, 2006; Wright & Decker, 1994) specifically said they only targeted empty properties. If the homeowner returned, the response of the majority was to 'run'. The very few exceptions (n=5, 8% participants) were those who did 'creeper' burglaries (anticipating if the homeowner is in, they are more likely to find wallets, keys, money, etc.):

'my type of burglary, the police call them creepers, so...you're more likely to find the money' (participant 64).

'I do creepers 'cause there's definitely stuff in the house' (participant 111).

'I used to like doing creepers because you're guaranteed to get money in there, like a wallet, a pin number' (participant 124).

Or those who targeted drug dealers (n=2, 3% participants):

'I used go out robbing crack dealers...they'd be in the house...I used to hold them hostage and...there's lots of money involved' (participant 108).

For many participants (n=22, 36%), the only reason for abandoning a burglary was due to being disturbed. Two years before data collection, a change in UK law increased right of householders to use reasonable force to protect their property. Two thirds of the sample said this would double their efforts to make sure the target was unoccupied:

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'...someone entering the premises, that changes the burglary into aggravated burglary' (participant 10).

'I wouldn't do a burglary while someone is in the house sleeping because it's classed as aggravated burglary. The time is quite...9 or 12 years, burglary is different' (participant 57).

Only a few participants reported that the recent change in the law would encourage them to carry a weapon for self-defense or that it would increase the likelihood of them making the situation more aggressive:

'now I think if you're approaching me with a weapon I'm going to approach back with a weapon' (participant 107).

For the vast majority, this change meant they would be extra careful not to meet their victims:

'one of a burglars worst nightmares is getting into a house and a) someone being there, didn't realize, or b) someone coming back, that's got to be the most frightening thing that can happen for the burglar as well as the people coming back' (participant 119).

'if you was ... breaking into someone's house you'd have to make sure no-one was in so you don't have to go equipped. You'd have one person at the front of the house knocking, and the other person would be in the back garden. You'd knock on one door and if no-one answered that house is good, and you'd literally do the whole row' (participant 138).

The use of the simulation enabled the research team, for the first time, to observe and record the routes taken by burglars inside the property, alongside their verbalizations. Kuipers, Tecuci and Stankiewicz (2003) describe the use of a 'route skeleton' heuristic by expert wayfinders – those familiar with the layout of an environment make a more efficient search that deviates from a central pathway (or spine) than novices who adopt a more haphazard, random approach to a search, and this was evidenced by the movements of participants here. The level of burglars' experience was

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apparent in the routes taken around the property. Twenty-two (36%) participants pointed out whilst navigating the property that this would be the 'usual' way they would approach their search. The systematic recording of these indicators of expertise, and identification of related verbalizations as participants undertook the burglary, and the subsequent development of ideas in the interview provides a clear justification for the use of the technique in developing the theory of dysfunctional expertise (Nee & Ward, 2015). Descriptions of the search included:

'start from the top and work my way down' (participant 88).

'first you have a quick glance at everything, then you go from top to bottom and then you grab everything that you think are most valuable and go.' (participant 91).

'check what's in every room, start upstairs and clear down, check in every room so you know what to grab on the way down, and obviously don't go anywhere near the kids room 'cause I've got kids myself and I'd never do that' (participant 117).

'The first thing a burglar does is go upstairs and look for gold. You wanna look for small items, expensive items. Especially if you can put them in your pocket so if you're walking out your walking out the same way you walked in. I would have double locked the front door as well. I went straight upstairs first. As I'm walking I'm clocking things, thinking I'm having that on the way down. Unless I see something really expensive, I will grab that, if it's small. If it's big, I'd unplug it, wrap it up and leave it where it is, in situ. Then I'd go upstairs, do whatever, normally jewelry boxes, cash, all burglars are looking for jewelry boxes and cash first of all, and then anything small that can be taken afterwards, and then TVs and that as a last resort, but you're always looking for small things first.' (participant 118).

Analysis of the quantitative data (reported in Nee et al., under review) indicated that burglars had more effective and efficient strategies and behavior in both scoping the neighborhood and undertaking the burglary, compared to the control groups. This provided an 'in vivo' replication

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of the heightened situational awareness of cues related to successful burglaries and dense cognitive schemas and scripts related to undertaking burglaries described recently by Nee (2015). The findings described in this section align with findings of previous research, demonstrating the validity of the Virtual Enactment Method in the investigation of burglary behavior. In addition, it allowed us, for the first time, to watch an experienced burglar 'in action', providing a fascinating insight into the actual commission of the crime. The additional free verbalizations, followed up by focused interviews allow for the identification of invaluable information for crime prevention, a benefit that can be further developed in future virtual reality research, both with burglars and other types of offenders.

### **Substance misuse and its impact on the criminal career**

An interesting finding that also highlights the added value of our method is the frequency with which participants reported feeling uncomfortable while exploring the environment, and that this feeling was experienced more vividly as they were experiencing the burglary sober, whereas in real life they would often have been under the influence of drugs. We can surmise that the simulation was successful in recreating the cognitive, motivational and emotional factors related to the offence, and that it encouraged participants to volunteer details considered by the offenders themselves to be most important in their offending behavior, however the difference in mental state (sober versus high) when committing the offence may be problematic in drawing further conclusions at this point. It is worth noting, however, that the level of expertise demonstrated by experienced burglars in their navigation of the environment, and the concurrent and subsequent verbalizations did not differ between those who identified drug use as a primary motivating factor and those who did not, and issue for the development of the theory of expertise discussed in more detail later.

The importance of drug use in the decision to offend emerged again as a theme when participants were asked about their previous offending history in order to categorize them according to their level of experience. Initial involvement in residential burglary generally began in the early

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teens, commensurate with the well-established age-crime curve (Farrington, 1986; Farrington, Piquero & Jennings, 2013). Early involvement in crime was often related to substance abuse with a third of participants directly linking the onset of their burglary behavior to drug use or addiction (most commonly cannabis and heroin, followed by crack cocaine). When talking about their criminal history, participants commonly described using burglary to fund a drug habit for a number of years, and then stopping their participation in burglary for a period in conjunction with abstinence from drug use. This time of 'clean living' appeared to come to an end for many with the development of heavy alcohol consumption, resulting in convictions for violent offences:

'[current conviction for] fighting, drinking too much. I was on drugs when I was doing burglaries, then I give up the drugs, then I started drinking'. (participant 85)

'Was doing a couple [of burglaries] a week, then gave up drugs, started drinking – fighting'. (participant 107).

We know from surveys of arrestees (Holloway & Bennett, 2004) and samples such as Cromwell, Olsen and Avery (1991), Clare (2011) and Wright and Decker (1994) that drug use is high in burglars. When discussing the frequency and time frame of their involvement in residential burglary, many participants in the current study reinforced the known link between drug use and burglary involvement (e.g. Bradford & Payne, 2012; Glaze & Herberman, 2013; McSweeney, Hough & Turnbull, 2007). Many specifically reported that they would only ever consider burglary as an option when drug dependence was a motivating factor (n=18, 30%):

'That's the only thing that's made me do crimes, if I'm not on drugs it wouldn't be entering my head... I don't agree with burglary at all but at the time when you're looking for your new way of making money for a fix, all the things go out the window to be honest' (participant 124).

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Given the low clearance rate for burglary and the high prevalence of drug misuse in residential burglars in general, and the findings described above, it seems reasonable to suggest that drug dependence does not adversely affect the development of expertise. Research into the effect of illegal drugs on cognitive functioning suggests that cannabis use and heroin use affect the areas of the brain controlling short-term memory and impulse control respectively (Lundkvist, 2005). Dysfunctional expertise, however, is dependent on long-term memory function (automatic recognition of cues stored in rich cognitive schemas, triggering routine behavioral scripts; see Nee & Ward, 2015). We note that even when completing the simulation in a (presumably) sober state, participants who reported the main motivation for burglary to be drug related demonstrated the use of expert decision-making in the completion of the virtual burglary, supporting this theory. One could suggest then, that while the use of illegal drugs may impact on motivations and goal-driven behavior leading up to, and after the offence, once engaged in the actual burglary itself, experienced burglars are able to function in a similar manner to non-drug using experts. This assertion, of course, needs considerable further research.

It is possible that the theory of dysfunctional expertise could explain why burglars very rarely get caught at the scene of the crime. The skill and expertise they show during the (often successful) commission of the offence is not reflected in their more chaotic lifestyle before and after the event, evidenced in the tendency for burglars to be identified and apprehended after the event (Burrows, 1986; Coupe & Griffiths, 1997; Farrington & Lambert, 2000). Extending the simulation to include the time periods before and after the burglary could be a valuable addition to the investigation of this theory. Participants did, however, admit that the need for drugs impacted their offence related behavior in a number of ways such as the tendency to take greater risks:

‘If you’re taking drugs you’ve got a lot more front, you don’t have any emotion, your sort of more brave...’ (participant 38).

Similarly, the care taken to avoid detection may be diminished. One participant stated:

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'I would be very mindful, wiping things, but when I become complacent I'm in the grips of drug addiction, although my plan is to do that, sometimes it doesn't work out that way. I might go careful, go in two gaffs and not get anything then I'm going to get sick if I don't get any money, then I might get complacent, leaving prints and stuff like that' (participant 23).

This type of behavior was commonly reported by the drug using participants. They often went to great lengths to demonstrate a level of conscience in the commission of the crime. This most commonly manifested in a desire to avoid entering children's bedrooms:

'when you go into the kids room [during the simulation], I don't like that, I wouldn't do that in real life, If I went into a kids room I'd just leave straight away' (participant 92).

'when I opened the door to the kids room I felt uncomfortable...when I opened that door and it's children's stuff, I'm not going in there' (participant 94).

'you walk into the baby's room with the cot and all that, that's why I didn't bother with going in there cause I don't do crap like that, it's like invading something, I know it's, I know you've gone through the whole house but for some reason kids stuff...' (participant 120).

'I wouldn't touch children's stuff, cause I've got kids and I know what it's like...taking someone's things, and karma as well, if you're stealing off of children you can expect that to come back on you' (participant 51).

Participants would also generally avoid targeting people that they knew, although this was again mediated by addiction:

'when I started using heroin a few years ago it makes you change the way you do burglaries, before, I had a conscience, I'd rather do it to a rich person than a council estate but it [drug addiction] makes you devious, I've even done it to people I know, it hurts me now...' (participant 43).

### **Additional insights identified through the use of the Virtual Enactment Method**

The possibility of free verbalization that can be encouraged further whilst using the simulation has the potential to uncover moral considerations from the perspective of the offender, and to explain the often conflicting reports of moral consideration and actual behavior highlighted by these quotes. The use of the 'think aloud' process requires that participants simply vocalize their actions and thoughts without further explanation, which in this case may identify the actual level of moral judgement used by offenders in undertaking the burglary – this may be at odds with their reporting, particularly after a time of reflection and possible intervention in prison. This evidence of remorseful reflection while undertaking the burglary is a novel aspect of our method, and a focus on this in future simulations may resolve some of the issues regarding discrepancies between reported and actual behavior.

Additionally, the findings suggest the need for further investigation of the role of drugs and alcohol in the escalation from acquisitive to violent offending. Clear links have been made between drug use and crime (e.g. Bradford & Payne, 2012; Lobmann & Verthien, 2008; McSweeney, Hough & Turnbull, 2007). Bennett, Holloway and Farrington (2008) support the causal link theory ('drug-use-causes-crime' or 'crime-causes-drug-use') suggesting the strength of the relationship depends on drug type and crime type. Casey (2015), however, notes the indirect link where drug use and crime are both caused by other variables, or a general association between drug use, offending and other problem behaviors and suggests that research that examines the link between drug use and the development of dysfunctional expertise is needed. Given the prevalence of drug use among this type of offender and the value of examining both expertise and drug use using the VEM, it is certainly worthy of further investigation.

### **Actions and feelings after the burglary**

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The most common action immediately after the burglary was to go and sell the goods. Twenty-three (38%) participants said that selling the goods would be their first priority. Disposal of stolen goods did not seem to be a problem for experienced burglars, with most having established criminal contacts in place, 'fencing' the items within a very short period of time:

'usually I'd have a car, if I didn't have one I'd have a bike. I won't usually go for stuff like TVs, I'd go for phones, laptops stuff like that. Jump on the bike and go, straight to the dealer and sell it, I won't hold on to anything ...20 minutes, half an hour' (participant 111).

'straight to sell it ... I wouldn't take it if it wasn't already sold' (participant 124).

This quick turnaround was important for two reasons; the immediate need for drugs and also the risk of being caught with stolen goods. Most participants would take the goods to the contact themselves, with only five (8%) participants stashing the goods for any period of time, either because they were involved in night time burglaries, or to allow the receiver of stolen goods to reach them:

'somewhere to stash the stuff, once you've stashed it try and find a buyer to for it right away. The quicker you get rid of the stuff the better' (participant 92).

The use of pawn shops or similar outlets appeared to be on the decline, due to the need for increased identification in recent years. Similarly selling goods on the internet was often considered to be too risky and too slow.

Regarding emotions or feelings immediately after the burglary, one third said they either felt nothing ('it's just like a job'), or that they were only concerned with the procurement of drugs:

'it didn't faze me at all, I done it to pay for drugs' (participant 55).

A number described excitement or an adrenaline rush (n=8, 13%):

'...especially if you get chased, that's just as addictive as any drug' (participant 108)

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or feeling 'great' after a good 'touch' (n=3, 5%), in line with Katz (1988) description of the euphoria of the thrill of acquisitive crime, and the intense elation reported by Wright and Decker's (1994) sample after the burglary. Only five (8%) participants reported any feeling of remorse immediately afterwards, more so in the longer term, after a period of non-burglary and a prison sentence:

'No not at the time, I know how unacceptable it is, how heart-breaking it is, but at the time I didn't care about, I didn't think about it, it wasn't anything personal, just thinking about drugs' (participant 85).

It is common for recovering addicts and desisting offenders to claim they were not 'being their real selves' when committing their crimes (Maruna, 2001). In a study of drug-related violence (car-jacking), Copes, Hochstetler and Sandberg (2014) reported many incidences of offenders saying drugs made them different and act in ways they would not normally behave. They proposed that drug use not only has implications for actions and moral decisions, but also fundamentally changes an individual's personality, while simultaneously acting as an explanation and justification for an individual's behavior. In the current study, the importance that participants placed on drug use as a motivator for their offending behavior supports these findings, and can be focused on in more detail in future research that uses the simulation.

### **Participants' experience of undertaking the 'mock burglary'**

Before we conclude, we reflect on the potential of our new visual methodology from the perspective of the 'experts' themselves. One of the main priorities of the Virtual Burglary Project was to demonstrate the effectiveness of this visual, interactive method as a tool to elicit more open, detailed responses during data collection. As such, one of the main focuses of the interview conducted after completion of the simulation was to understand participants' experience of undertaking the simulation. Many participants vocalized their feelings as they navigated the virtual

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neighborhood, allowing for discussion of the simulation in much greater detail, and for post-simulation interviews to be targeted directly toward the issues identified by individual participants.

Participants engaged in the simulation, and were often very keen to identify ways in which it reflected real-life experiences, as well as share ways in which they felt it should be improved:

‘it would probably get some people talking about it, some people bottle it up and don't talk about it, like coming in today, doing this, I probably wouldn't have talked about it’

(participant 72).

Harper (2002) observed that the use of photographs in sociological research showed, from the perspective of informants, how little the researcher understood of their world, prompting them to give suggestions on how to improve the process. Similarly, Collier & Collier (1986) described how participants became experts, leading the researchers through the content of the research. We experienced a similar desire to ‘teach’ us where we were going wrong, and uncovered more detailed information about the burglary event in the process.

Improvements to the simulation were generally related to its usability (desire to move more quickly, duck under windows, creep, jump over fences and so on), or ways to make the search more realistic (more things hidden, being able to tip over beds, look on top of wardrobes or under beds). Feedback on the layout of the house and the realism of the layout compared to real-life was in general positive:

‘the sort of things you go for are laying about there, like money and...’ (participant 43).

And the most common criticism was the method of entry to the property:

‘it's quite good apart from you don't have to break in, it was quite effective really’

(participant 43).

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As mentioned earlier, while each of the properties that could be targeted were designed to look different from the street (blinds up or down, different items in the window), once up close the interior layout of the property could be clearly seen. A number of participants noticed during their 'scouting' period that all the properties were identical inside, and that this reduced the level of realism. This is an issue that can be addressed in future, more detailed simulations, but does demonstrate the level of awareness of the burglars as they rapidly assessed the environment, and is also an example of how the use of the simulation identified aspects of behavior that might not have arisen in interview.

The inclusion of more high value goods in the house would improve the realism, as would incorporating the need to break in to the house, and to 'rummage' to find valuable items. More people, either moving in the street outside or inside the property would also be a valuable addition. These improvements, as identified by the 'experts' themselves, are relatively easy to incorporate into future simulations, and despite these limitations, comments demonstrating the immersiveness of the simulation were common:

'I was kind of panicking actually, what to do, where to go' (participant 63).

'uncomfortable, but that was only like the first couple of minutes, after that I forgot about what I was thinking and feeling' (participant 87)

The simulation was successful in eliciting an emotional response in some participants, and this was generally related to feelings of discomfort when entering and searching the property. The unease reported was most often in relation to the invasion of another person's property rather than any fear of being caught, demonstrating the success of the simulation in eliciting remorseful reflection. This is to be expected, as there was no actual risk involved for the participant, but also may be influenced by the participants current situation (in prison, where reflection on past behavior is more likely, and may be encouraged through intervention programs):

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'it made me feel uncomfortable about the whole situation' (participant 87).

'uncomfortable, it's not nice' (participant 45).

'I felt bad going through the kid's room and that, and the babies stuff and that, but that's the stuff that sells unfortunately' (participant 77).

'I had real butterflies in my stomach' (participant 102)

The process also successfully reminded some participants of other emotions and feelings experienced when committing a burglary, and we feel that introducing some element of risk (setting off an alarm, police sirens etc.) in future simulations could increase this experience:

'quite exciting. You do get a massive adrenaline rush when you're doing things ... it's not always about the money, it's about the buzz...the thrill of being chased, if you're being chased by the police, your hearts all like this, it's better than any drug...you'd want to go out and do it again, more the thrill of it see... for me it just brought back all the memories.'  
(participant 108).

For those who felt that the simulation was not sufficiently similar to a real burglary, or that described it as 'just a game', it is interesting to note that the level of disclosure and spontaneous discourse while navigating the neighborhood and in the interview afterwards was not noticeably different than for those who reported feeling more engrossed or emotionally engaged in the simulation.

The tendency for even the most reticent participants to want to highlight the limitations of the virtual neighborhood, and to teach us about how we could have done it better was a valuable and unexpected additional source of rich information, which could then be built upon further in the post simulation interview. Once engaged in the task, and having already mentioned these improvements whilst navigating the neighborhood, they were more inclined to elaborate when

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prompted later, and undoubtedly shared more information about their skill and experience than they would have in an interview alone. The use of interview methods with offenders is an invaluable tool in creating a rich picture of offender experiences, incorporating factors such as motivations, decision-making, circumstances and methods used in the commission of the crime (Horney, 2001), but may be subject to the limitations of memory. Nee (2004, 2010) provides an extensive review of how the use of methods that include memory retrieval cues (such as the simulation described here, and tools such as the life event calendar; Freedman, Thornton, Camburn, Alwin & Youg-DeMarco, 1988) alongside an interview significantly improve the accuracy of memory in recalling past criminal events. Nee (2010) also suggests that intellectual engagement in demanding cognitive tasks (such as the virtual burglary) increase the validity of the response and decrease deception, a benefit that we feel has been demonstrated here in the responses of participants in the current research, and that can undoubtedly be built upon in future research using the Virtual Enactment Method (VEM).

Finally, the feedback recorded from participants' comments while completing the virtual burglary, and from direct questions in the interview provides us with an invaluable insight, from the mouths of the experts themselves into how future simulations can be developed to gather even more valuable and relevant data about the burglary event and the motivations and decision-making leading up to, and after the burglary itself.

## Conclusion

The findings of the research described here demonstrate how the use of virtual reality to study burglary can bring us closer to observing and recording burglary behavior as it occurs. The use of the simulation as a research tool was successful not only in systematically replicating and recording quantitative indicators of expertise as they unfold, but also in providing an additional, qualitative insight into the decisions made, in real time, as the burglary progressed. For some, this

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amounted to almost a 'running commentary', for others it was one word utterances that added context to the movement around the property and the targeting (or not) of certain items. The encouragement of 'thinking aloud' by participants as they completed the virtual burglary, and the tendency of participants to go into greater depth about their actions as they 'taught' the researchers what was wrong or missing from the simulation, elicited greater contextual information about target selection and the search than has previously been found using less immersive visual techniques. This can be developed further in future studies using the VEM to provide valuable information for situational crime prevention strategies that consider motivations and emotions of the offender and the changing interaction of environmental cues. The verbal data elicited from participants as they navigated the virtual environment in combination with the post-burglary interview were in line with earlier burglary research but in combination with our novel method provided an unprecedented level of detail regarding the burglar's cognitions, emotions and behavior.

The further development of the Virtual Enactment Method to improve the level of realism (guided by the insights of the offenders themselves in this pilot study) will in turn increase the level of immersion in the environment and engagement in the task, resulting in even higher levels of disclosure and insights into offence related knowledge. Improvements to the look and feel of the simulation may be supplemented by the inclusion of added risk and reward for the participants (e.g. the risk of setting off an alarm, occupants returning, police sirens, and a means of participants measuring their 'haul') to increase the realism of the task, and so, engagement and disclosure.

By using virtual reality to study burglary, responses to environmental cues indicating security and reward, search methods and the desirability of specific items within the target property can be observed, systematically recorded, and meaningfully researched, informing crime prevention strategies. Similarly, understanding indicators of expertise in burglars, especially the automatic and unconscious nature of the cognitive processes used by experienced offenders, has significant implications for appropriate interventions at different phases in the development of the criminal

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career (see Nee & Vernham, 2016). Offender insights volunteered during and after the use of the simulation can be used to provide a current and relevant perspective on the burglary event itself, the motivations for involvement in crime (both generally and specifically to burglary), and the possible reasons for desistance from crime, with implications for both crime prevention and intervention<sup>3</sup>. The methodology can be further enhanced by the use of measures of biological reactions such as heart rate and skin conductivity, and the use of eye tracker technology. The use of virtual reality headsets in future research will increase the immersiveness of the environment. Headsets were used in a student study using this simulated neighborhood (Van Gelder et al, 2015) but were not at the time user-friendly enough to involve in the study with prisoners. The richness of the data, both qualitative and quantitative, gathered from the use of this new visual tool, despite the limitations of the current simulation, demonstrate the potential value of developing the VEM for use not only in burglary research, but in a wide range of offender based research. Immersion in virtual reality seems to overcome the two major obstacles criminologists face in understanding offending behavior when interviewing offenders: retrieval from memory and motivation to disclose.

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<sup>3</sup> For instance, these insights could contribute significantly to the 'Transforming Rehabilitation Agenda' (Ministry of Justice, 2013) in the UK which, for the first time, is aimed at addressing the needs of acquisitive offenders as well as their more violent counterparts.

## References

- Anon. 2010. "FBI Releases 2009 Crime Statistics". Retrieved December 21, 2016  
(<https://archives.fbi.gov/archives/news/pressrel/press-releases/fbi-releases-2009-crime-statistics>).
- Anon. 2015. "Crime Survey For England & Wales". Retrieved December 20, 2016  
(<http://www.crimesurvey.co.uk/>).
- Anon. 2016. "Bureau Of Justice Statistics (BJS) - Burglary". Retrieved December 21, 2016  
(<http://www.bjs.gov/index.cfm?ty=tp&tid=321>).
- Bagnoli, A., (2009). Beyond the standard interview: the use of graphic elicitation and arts-based methods. *Qualitative Research*, 9(5), 547-570.
- Barton, K., C. (2015) Elicitation techniques: Getting people to talk about ideas they don't usually talk about. *Theory and Research in Social Education*, 43(2), 179-205.
- Bennett, T. & Wright, R. (1984). *Burglars On Burglary: Prevention And The Offender*. Aldershot, England: Ashgate Publishing.
- Bernasco, W. & Luykx, F. (2003). Effects of attractiveness, opportunity and accessibility to burglars on residential burglary rates of urban neighbourhoods. *Criminology*, 41(3):981-1002.
- Bernasco, W. & Nieuwebeerta, P. (2005). How do residential burglars select target areas?. *British Journal of Criminology*, 45(3):296-315.
- Bradburn, N. M., Rips, L. J., and Shevell, S. K. (1987) Answering Autobiographical Questions: The Impact of Memory and Inference in Surveys. *Science*, 236(4798), 157-161.
- Bradford, D., & Payne, J. (2012) Illicit drug use and property offending among police detainees. *Crime and Justice Bulletin 157*. Sydney: NSW: Bureau of Crime Statistics and Research.
- Brantingham, P. (1975). Residential burglary and urban form. *Urban Studies*, 12(3):273-284.
- Brantingham, P. J., & Brantingham, P. L. (1991). *Environmental Criminology*. Illinois: Waveland Press.
- Brantingham, P. L., & Brantingham, P. J. (2004) Environment, routine & situation: toward a pattern crime theory. In Ronald V. Clarke & Marcus Felson (Eds.) *From Routine Activity & Rational Choice: Advances in Criminological Theory*. (Vol. 5, pp.259-294). New Jersey: Transaction Publishers.
- Burrows, J. (1986). *Investigating Burglary: The Measurement Of Police Performance*. London, United Kingdom: Stationery Office Books.
- Casey, S. (2015). Offending: Drug-related expertise and decision making. *Aggression and Violent Behavior*, 20:82-91.

## Understanding burglary through virtual reality

- Ceccato, V. (2016). *Rural crime and community safety*. Abingdon, NY: Routledge.
- Chiozzi, P. (1989). Photography and anthropological research: three case studies. In Robert Boonzajar Flaes, (Ed.), *Eyes Across the Water*. Amsterdam: Het Spinhuis, 43-50.
- Clare, J. (2011). Examination of systematic variations in burglars' domain-specific perceptual and procedural skills. *Psychology, Crime & Law*, 17(3):199-214.
- Cohen, J. (2005). Object and Walking Probes in Ethnographic Interviewing. *Field Methods*, 17(2), 200-204.
- Collier, J. (1957). Photography in anthropology: a report on two experiments. *American Anthropologist*, 59: 843-859.
- Collier, J. & Collier, M. (1986). *Visual Anthropology: Photography as a Research Method* (revised and expanded). Albuquerque: University of New Mexico Press.
- Copes, H., Hochstetler, A., & Sandberg, S. (2014). Using a narrative framework to understand the drugs and violence nexus. *Criminal Justice Review*, 40 (1), 1-15.
- Coupe, T. & Blake, L (2006). Daylight and darkness targeting strategies and the risks of being seen at residential burglaries. *Criminology*, 44(2):431-464.
- Cromwell, P., Olson, J., D'Aunn, W. & Avary, W. (1991). *Breaking And Entering: An Ethnographic Analysis Of Burglary*. United States: SAGE Publications.
- Darley, J. & Latane, B. (1968). Bystander intervention in emergencies: Diffusion of responsibility. *Journal of Personality and Social Psychology*, 8(4):377-383.
- De Leon, J. & Cohen, J. (2005). Object and walking probes in ethnographic interviewing. *Field Methods*, 17(2):200-204.
- Elffers, H. (2010). Misinformation, misunderstanding and misleading as validity threats to accounts of offending. In Bernasco, W. (Ed.) *Offenders on Offending: Learning about Crime from Criminals*, Willan Publishing.
- El Guindi, F. (1998). From pictorializing to visual anthropology. In H. Russel Hernard, (Ed.), *Handbook of Methods in Cultural Anthropology*. London: Sage 459-511.
- El Guindi, F. (2000). From pictorializing to visual anthropology. In *Handbook of methods in cultural anthropology*. H. R. Bernard (Ed.) Walnut Creek, CA: AltaMira.
- Ericsson, K., & Simon, H. (1993). *Protocol Analysis: Verbal Reports as Data (2nd ed.)*. Boston: MIT Press.
- Farrington, D. (1986). Age and crime. *Crime and Justice* 7:189.
- Farrington, D., Bennett, T. & Holloway, K. (2008). *Effectiveness of treatment in reducing drug-related crime*. Retrieved December 21, 2016

- [http://www.crim.cam.ac.uk/people/academic\\_research/david\\_farrington/drugsw.pdf](http://www.crim.cam.ac.uk/people/academic_research/david_farrington/drugsw.pdf)
- Farrington, D., & Lambert, S. (2000). Predicting offender profiles from offense and victim characteristics. In Richard N. Kocsis (Ed.) *Criminal Profiling: International Perspectives in Theory, Practice and Research*. Humana Press.
- Farrington, D., Piquero, A., & Jennings, W. (2013). *Offending from childhood to late middle age: Recent results from the Cambridge study on delinquent development*. New York: Springer-Verlag New York.
- Freedman, D., Thornton, A., Camburn, D.A., Young-DeMarco, L. (1988). The Life History Calendar: A Technique for Collecting Retrospective Data. *Sociological Methodology*, 18, 37-68.
- Friedland, G., & Sommer, R. (2010). Cybercasing the Joint: On the Privacy Implications of Geo-Tagging. In HotSec.
- Friedrich, K. (2016). Therapeutic Media: Treating PTSD with virtual reality exposure therapy. *Media Tropes*, 6 (1), 86-113.
- Garcia-Retamero, R. & Dhami, M. (2009). Take-the-best in expert-novice decision strategies for residential burglary. *Psychonomic Bulletin & Review*, 16(1):163-169.
- Glaze, L. E. & Gerberman, E. J. (2013) *Correctional populations in the United States, 2012*. Washington DC: US Department of Justice, Office of Justice Programs, Bureau of Justice Statistics.
- Grey, N. & Holmes, E. (2002) Cognitive restructuring within reliving: A treatment for peritraumatic emotional "Hotspots" in posttraumatic stress disorder. *Behavioural and Cognitive Psychotherapy*, 30, 37-56.
- Harper, D. (1988). Visual sociology: expanding sociological vision. *The American Sociologist* 19(1): 54-70.
- Harper, D. (2002). Talking about pictures: a case for photo elicitation. *Visual Studies*, 17(1)13-26.
- Holloway, K. & Bennett, T. (2014). *Drug use and offending: Summary results of the first two years of The NEW-ADAM Project*. Retrieved December 21, 2016 (<http://www.dldocs.stir.ac.uk/documents/r179.pdf>).
- Horney, J. (2001) Criminal events and criminal careers. In: Meier R, Kennedy L, Sacco V (Eds.) *The process, structure of crime: criminal events, crime analysis*. Transaction Publishers, New Brunswick
- Katz, J. (1988). *Seductions of crime: The moral and sensual attractions of doing evil*. 5th ed. New York: Basic Books.
- Kearns, J. N. and Fincham, F. D. (2005). Victim and perpetrator accounts of interpersonal transgressions: Self-serving or relationship-serving biases?. *Personality and Social Psychology Bulletin*, 31(3):321-333.

## Understanding burglary through virtual reality

- Kershaw, C., Budd, T., Kinshott, G., Mattinson, J., Mayhew, P., & Myhill, A. (2000). *The 2000 British crime survey*. London, England: Home Office.
- Kuipers, B., Tecuci, D., & Stankiewicz, B. (2003). The skeleton in the cognitive map: a computational and empirical exploration. *Environment and Behavior* 35 (1), 80-106.
- Lambert, S. & Farrington, D. (1994). Differences between burglars and violent offenders. *Psychology, Crime & Law*, 1(2):107-116.
- Langton, L. & Truman, J. (2015). Bureau Of Justice Statistics (BJS) - Criminal Victimization, 2014. Retrieved December 20, 2016 (<http://www.bjs.gov/index.cfm?ty=pbdetail&iid=5366>).
- Lundqvist, T. (2005). Cognitive consequences of cannabis use: Comparison with abuse of stimulants and heroin with regard to attention, memory and executive functions. *Pharmacology, biochemistry, and behavior*, 81(2):319-30.
- Maguire, M. & Bennett, T. (1982). *Burglary in a dwelling: The offence, the offender and the victim*. London: Ashgate Publishing.
- Maruna, S. (2004). Desistance from crime and explanatory style: A new direction in the psychology of reform. *Journal of Contemporary Criminal Justice*, 20(2):184-200.
- McSweeney, T., Hough, M., & Turnbull, P. (2007). Drugs and Crime: Exploring the links. In M. Simpson, T. Shildrick, & R. MacDonald (Eds.). *Drugs in Britain: Supply, consumption and control*. Basingstoke, UK: Palgrave Macmillan.
- Milgram, S. (1963). Behavioral study of obedience. *The Journal of Abnormal and Social Psychology*, 67(4):371-378.
- Moffitt, T. E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: A developmental taxonomy. *Psychological Review*, 100(4):674-701.
- Morrow, V. (1998). If you were a teacher, it would be harder to talk to you: reflections on qualitative research with children in school. *International Journal of Social Research Methodology: Theory and Practice*, 1, 297-313.
- Nee, C. (2004). The Offender's Perspective on Crime: Methods and Principles in Data Collection. In A. Needs and G. Towl (Eds.) *Applying Psychology to Forensic Practice*. London: BPS Blackwell.
- Nee, C. (2000). Examining burglars' target selection: Interview, experiment or ethnomethodology? *Psychology, Crime & Law*, 6(1), 45-59.
- Nee, C. (2010). Residential burglary: methodological and theoretical underpinnings. In J. Brown and E. Campbell (Eds.) *Cambridge handbook of forensic psychology*. First edition. Cambridge: University of Cambridge Press.
- Nee, C. (2015). Understanding expertise in burglars: From pre-conscious scanning to action and beyond. *Aggression and Violent Behavior*, 20:53-61.

## Understanding burglary through virtual reality

- Nee, C. & Meenaghan, A. (2006). Expert decision making in burglars. *British Journal of Criminology* 46(5):935-949.
- Nee, C. & Taylor, M. (1988). Residential burglary in the Republic of Ireland: A situational perspective. *The Howard Journal of Criminal Justice*, 27(2):105-116.
- Nee, C. & Taylor, M. (2000). Examining burglars' target selection: Interview, experiment or ethnomethodology? *Psychology, Crime & Law*, 6(1):45-59.
- Nee, C., Van Gelder, J-L., Otte, M, Vernham Z. and Meenaghan, A. (under review). Dysfunctional reality: how virtual worlds help us understand expertise in burglars.
- Nee, C. & Vernham, Z. (2016). Dysfunctional expertise and its relationship with dynamic risk factors in offenders. *Psychology, Crime and Law*, 22(1-2),47-67.
- Nee, C. & Ward, T. (2015). Review of expertise and its general implications for correctional psychology and criminology. *Aggression and Violent Behavior*, 20:1-9.
- Nee, C., White, M., Woolford, K., Pascu, T., Barker, L., & Wainwright, L. 2014. "New Methods For Examining Expertise In Burglars In Natural And Simulated Environments: Preliminary Findings". *Psychology, Crime & Law* 21(5):507-513.
- Nisbett, R. E., and Wilson, T. D. (1977). Telling More Than We Can Know: Verbal Reports on Mental Processes. *Psychological Review*, 84(3), 231-259.
- Prince William County Police Force. How burglars use social media. Retrieved 04/05/2017 (<http://www.pwcgov.org/government/dept/police/pages/how-burglars-use-social-media.aspx>).
- Reppetto, T. (1974). *Residential Crime*. Cambridge, MA: HarperCollins Distribution Services.
- Scarr, H. A. (1973). *Patterns of burglary*. Washington Dc: Government Printing Office.
- Shevell, S., Rips, L., & Bradburn, N. (1987). Answering autobiographical questions: The impact of memory and inference on surveys. *Science*, 236(4798):157-61.
- Shover, N. (1973). The social organization of burglary. *Social Problems*, 20(4):499-514.
- Slater, M., Antley, A., Davison, A., Swapp, D., Guger, C., Barker., C. & Sanchez-Vives, M. (2006). A virtual reprise of the Stanley Milgram obedience experiments". *PLoS ONE* 1(1):e39.
- Slater, M., Rovira, A., Southern, R., Swapp, D., Zhang, J. Campbell, C., & Levine, M. (2013). Bystander responses to a violent incident in an immersive virtual environment. *PLoS ONE* 8(1):e52766.
- Smith, O., 2013. *Social networking increases burglary risk*. Retrieved 04/05/2017 (<http://www.telegraph.co.uk/travel/news/Social-networking-increases-burglary-risk/>).
- Smith, K., Taylor, P., Elkin, M. (2013) *Crime detected in England and Wales 2012/2013*. Home Office Statistical Bulletin. Retrieved 08/05/2017 [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/224037/hosb0213.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/224037/hosb0213.pdf)

## Understanding burglary through virtual reality

- Snook, B., Dhimi, M. & Kavanagh, J. (2011). Simply criminal: Predicting burglars' occupancy decisions with a simple heuristic. *Law and Human Behavior*, 35(4):316-326.
- Stankiewicz, B., Tecuci, D. & Kuipers, B. (2003). The skeleton in the cognitive map: A computational and empirical exploration. *Environment & Behavior*, 35(1):81-106.
- Stirling, G. (2011) *Ex-burglars believe Google StreetView, Facebook, Twitter & Foursquare used to plot crimes*. Retrieved 08/05/17 <http://searchengineland.com/burglars-favorite-tools-google-facebook-foursquare-94628>.
- Taylor, M. & Nee, C. (1988). The role of cues in simulated residential burglary. *British Journal of Criminology*, 28:105-116.
- Towl, G., & Needs, A. (2004) . *The offender's perspective on crime: methods and principles in data collection*. Oxford: Blackwell Publishers.
- Vandeviver, C. (2014). Applying Google Maps and Google Street View in criminological research. *Crime Science*, 3:13.
- Van Gelder, Jean-Louis, Marco Otte, and Eva C. Luciano. "Using virtual reality in criminological research." *Crime Science* 3.1 (2014):10.
- Van Gelder, J-L., Nee, C., Otte, M., van Sintemaartensdijk, I., Demetriou, A., van Prooijen, J-W. (2016). Virtual Burglary: Exploring the potential of virtual reality to study burglary in action. *Journal of Research in Crime & Delinquency*, 54(1): 29-62.
- Verthein, U. & Löbmann, R. (2008). Explaining the effectiveness of heroin-assisted treatment on crime reductions. *Law and Human Behavior*, 33(1):83-95.
- Waller, I. & Okihiro, N. (1979). *Burglary: The victim and the public*. Toronto: Published in association with the Centre of Criminology, University of Toronto by University of Toronto Press.
- Warr, M. (2000). Fear of crime in the United States: Avenues for research and policy. *Criminal Justice*, 4, 451-489
- Wilson, T. & Nisbett, R. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review*, 84(3):231-259.
- Wright, R. T. & Decker, S. (1994). *Burglars On The Job: Streetlife And Residential Break-Ins*. Boston: Northeastern University Press.



Figure 1: The virtual neighborhood



Figure 2: Internal layout (living room) including lootable items