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A comparison of younger and older burglars undertaking virtual burglaries: the development of skill and automaticity

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Abstract

Objectives The study examines the development of offence-related expertise over time and age in a sample of convicted burglars.

Methods A quasi-experimental design was used to assess indicators of expertise in younger (n=36) and older (n=32) burglars as they completed a "virtual burglary". It was predicted that (i) older burglars would use more efficient scoping and searching strategies than younger burglars, and (ii) older burglars would be more discerning in their selection of items to steal than younger burglars.

Results Findings suggested that indicators of expertise were evident in both age groups however, compared to younger burglars, older burglars demonstrated more developed expertise in relation to items stolen and the efficiency of the search.

Conclusions The research supports the role that expertise plays in offence-related decision-making across the criminal career. It provides additional support for the use of VR to assess offender expertise.

Keywords Expertise · Burglary · Virtual reality

Expertise, the product of learning and experience in a specific domain, can be considered on a continuum from novice to expert (Bedard & Chi, 1992; Chi, 2006). While few people reach mastery in a particular domain, most can achieve skills sufficient for superior performance compared to those inexperienced within a field (e.g., learning to drive a car, learning a new language). Recently, knowledge of expertise from work in the domain of cognitive psychology has been applied to offending behavior (Nee & Ward, 2015). The study of residential burglary has been invaluable

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in developing a theory of expertise in offending (known as "dysfunctional expertise"; Nee & Ward, 2015), demonstrating that those with experience of committing burglary perform in a superior and more efficient manner than both non-burglar offenders and non-offenders (Nee, 2015; Nee et al., 2019).

Decision-making guided by expertise is intrinsically different to decision-making by novices. In the offending domain, expertise will not only influence the actual undertaking of an offence but may also impact on whether a crime is initiated at all. Expertise requires practice and repetition; therefore, its impact on behavior will increase as a function of experience. While skilled decision-making has been observed in experienced offenders compared to novices, the process and speed by which expertise accrues, to a point where it will impact on decision-making, is unclear. This paper presents an experimental comparison of the undertaking of a virtual burglary by younger and older burglars, focusing on indicators of expertise between the groups. The aim is to assess the extent to which skill acquisition impacts decision-making between offenders of different ages, and at different stages of the criminal career, with potential implications for rescinding the criminal career and informing targeted intervention strategies.

Expertise

Expertise, as identified in mainstream, cognitive psychology (through studies of, for example, chess, medicine and music) refers to the "characteristics, skills and knowledge that distinguish experts from novices and less experienced people" (Ericsson, 2006 p. 3). Experts develop the capacity for superior and more efficient performance through repeated practice and learning within a domain of experience. Repeated exposure to patterns of domain-relevant cues results in these cues being "chunked" together in long-term memory (Chase & Simon, 1973). As a result, cues can be retrieved more easily, and responses to future expertise-related tasks can be carried out more efficiently (Shanteau, 1992). Additionally, successful responses to cues are also stored in long-term memory, leading to the development of cognitive scripts (memory shortcuts that simplify decision-making; Fiske & Taylor, 1991). Consequently, experts can respond automatically to relevant stimuli, freeing up space for attention to more conscious and immediate matters (see the computational modeling work of Palmeri et al., 2004). The automatic nature of expert decision-making also creates a state of 'eternal vigilance' to relevant cues (Bargh, 1994, p.5), thus the processes associated with skilled decision-making are in constant operation and are very difficult to 'switch off' (Bechara & Damasio, 2005). Put simply, the expert is constantly, and preconsciously, attuned to stimuli within the domain of expertise.

Early work using visual search and detection tasks (e.g., Schneider & Shiffrin, 1977) assumed thousands of repetitions of a relevant action would be necessary for the development of proficiency. This theory has since been disputed, with evidence for skill development in the very early stages of experience (Bargh, 1994), supporting the notion of expertise as a continuum from novice to expert (Chi & Bassok, 1989). Neuroimaging work (Hill & Schneider, 2006) has also indicated brain changes in relation to learning after as little as one hour of practice. Accordingly, individuals may demonstrate less developed skill in the early stages of experience; however, this can be built on with ongoing practice. In line with the speedy acquisition of skills in normative domains, competencies associated with offending expertise may also develop from early on in experience. Adding depth to the skill acquisition continuum in offending (Nee et al., 2019) note that, when attempting to assess capabilities in an offending domain, it may be necessary to also consider the additional category of 'naivette'. According to Chi (2006), the naivette is an individual with no prior knowledge of the domain in question. The distinction between naivettes (in the case of existing burglary research, student or non-offender controls) and novices (for example, an offender with little or no experience of burglary) allows for additional nuance in investigating the impact of expertise on offence-related decision-making as experience accrues. The development of expertise does not come without potential drawbacks (e.g., see Chi, 2006; Dror et al., 2011; Woollett & Maguire, 2010), and these will be summarized below. First, the application of expertise to offender decision-making will be outlined.

Dysfunctional expertise

The theory of 'dysfunctional expertise' (Nee & Ward, 2015) promotes the application of this functional, pro-social expertise paradigm, to anti-social domains. Nee (2015) proposed four key stages of decision-making in which expertise is manifest. First, the offender constantly and preconsciously assesses the environment in a relatively automatic way. Second, during this appraisal, relevant offence-related cues are recognized more effectively than would be observed by a novice. Third, cues relevant to the domain of expertise trigger complex cognitive schema, and guide decision-making based on learning from past experience. Finally, actions are carried out in response to environmental cues, based on successful past responses, enabling the offence to be conducted in a relatively automatic way (Nee, 2015). The study of residential burglary provides compelling support for the dysfunctional expertise model. The decades of research into various aspects of burglary-related decision-making are briefly summarized below, indicating evidence of superior cognitive processes in experienced offenders compared to novices. This provides context for the current study, which aims to investigate the specific impact of expertise in younger compared to older burglars, i.e., at different stages of their criminal career, taking into consideration the extent of experience in burglary between the two age groups.

Expertise in residential burglary

Indicators of expertise and automaticity in the navigation of a neighborhood and target selection emerged in even the very early burglary research. Shover (1973) described how experienced burglars spend their free time 'scoping' for opportunities to offend, while Wright and Decker (1994) p. 80 described this as a process of 'half-looking'. Rather than actively searching for targets, offenders are constantly attuned to their surroundings as part of their day to day lives, reflecting the eternal vigilance described by Bargh (1994). While assessing a property for its suitability to burgle, experienced burglars show superior memory for relevant environmental cues (e.g., occupancy, security, and accessibility) compared to police officers, householders, non-burglar offenders and matched non-offenders (Logie et al., 1992; Wright et al., 1995). Nee and Taylor (2000) also demonstrated more efficient navigation of a neighborhood and more effective assessment of environmental cues indicating relative affluence and vulnerability of a property in burglars compared to householders. Similarly, van Sintemaartensdijk et al. (2022) used an extensive virtual environment, depicting a residential neighborhood, to show accomplished navigation and target selection decisions in experienced burglars. Such research, using experimental comparison between novices and experts provides valuable support for the notion that target selection decisions may be subject to skill acquisition, with superior performance being related to specific burglary experience.

In a novel experimental study comparing the burglary of a real house to a virtual replica, Nee et al. (2015) demonstrated superior judgment in entry decisions by experienced burglars compared to students. The novice students accessed the properties (both real and virtual) through the front door, while burglars chose a more concealed rear entry point. Further support was provided in Nee et al. (2019), where burglars were found to be significantly more likely to select an end-of-terrace property, and enter through a rear entrance, indicating knowledge of methods to avoid detection during target selection. Both studies also demonstrated the role of experience in enabling the burglars to conduct a more skilled search, focusing on areas of likely high yield (Nee et al., 2015; Nee et al., 2019). Burglars specifically targeted the master bedroom, where valuable items such as jewelry tend to be located, a finding also noted by Wright and Decker (1994). Similarly, the analysis of interviews with experienced burglars by Nee and Meenaghan (2006) revealed a habitual search pattern, which progressed from the master bedroom to other bedrooms, before a cursory search of downstairs. In support of the theory of learning through experience and of the use of cognitive scripts to guide behavior, these search patterns were based on what had been lucrative and successful in the past. Contrastingly, novices have been observed to employ a far more haphazard search strategy, as evidenced by the students in Nee at al. (2015) sample, and earlier experiments with householders (Nee & Taylor, 2000).

This brief overview of evidence for expertise in residential burglars demonstrates skilled decision-making in those with experience compared to those without; however, less is known about the impact of expertise within burglar groups. Work assessing proficiency in very young offenders is limited to one study by Logie et al. (1992), and only Clare (2011) has made comparisons between burglars with varying levels of experience. The latter indicated finer perceptual and procedural knowledge in more experienced burglars compared to those with less experience, thus indicating the continued development of expertise as a function of practice and learning. The current research aims to build on this finding to gain a greater understanding of the continuum of expertise at different stages of the criminal career.

Benefits and limitations of expertise

Studying offending behavior through an expertise lens has several benefits. From a theoretical perspective, it provides the opportunity to explore and explain the ‘bounded’ nature of decision making associated with Rational Choice Theory (Cornish & Clarke, 1986). Expertise enables inferences to be made based on partial information through the use of heuristics. Cognitive scripts can be generalized to novel (but partially familiar) situations, extending the scope of expertise beyond direct experience (Duckworth et al., 2002; Gilovich, 1981). Accordingly, burglars are not limited to offending in only familiar locations, or to targeting similar properties. Expertise also facilitates multi-tasking, as the use of cognitive scripts reduces cognitive load and dual-task interference (Logan & Etherton, 1994). The well-learned tasks associated with the domain of expertise demand a reduced level of cognitive resource, freeing up space for the assessment of more demanding, unfamiliar tasks. The expert can therefore focus their cognitive resources on more novel, less rehearsed tasks arising from the immediate situation. The burglar, for example, can complete the burglary relatively automatically while concentrating on listening for returning homeowners, as noted in interviews with experienced burglars by Nee and Meenaghan (2006).

These cognitive processes provide clear benefits for the offender, as superior processing enables a more successful, safer, and more profitable offence. From a rational choice perspective, the potential for increased reward, alongside the reduction in the risk of being caught increases the likelihood of repetition of the behavior. However, expert decision-making is also associated with some limitations, which may be exploited for crime prevention purposes. The use of cognitive shortcuts allows for fast and economical decision-making but has the potential to result in errors when the available information is limited or ambiguous, or when faced with pressurized situations (Klein, 2009; Nee & Ward, 2015). The reliance on cognitive scripts can result in inflexibility and a reduced ability to problem solve creatively (Ericsson & Lehmann, 1996). Experts may also be subject to bias in their assessment and be overconfident in their decisions, as demonstrated in Chi’s (2006) review of evidence drawn from experts in the fields of chess, physics, medicine, and music. Additionally, when encountering unfamiliar or unexpected stimuli, the expert is forced to move from automatic thinking to more deliberative thinking. Existing cognitive scripts, still triggered by the partially familiar environment, must be negotiated alongside the burden of new information, increasing the cognitive load. This effect has been noted in the navigational strategies of London taxi drivers (Woollett & Maguire, 2010) and the cognitive processing of chess players (Saariluoma, 1992). In the forensic field, a series of studies by Dror and colleagues (e.g., Dror et al., 2011) attempted to uncover underlying explanations for errors made by fingerprint experts. These indicate that cognitive and psychological processes, including contextual biases and emotions, result in inconsistent and potentially erroneous decision making not only between experts, but also within experts. They highlighted the dynamic nature of human information processing, which allows for effective processing of large amounts of information, but can also distort perception of information, resulting in errors (Dror et al., 2011).

Nee and Ward (2015) propose that crime prevention strategies that exploit the environment (for example, changing aspects of the crime scene), thus disrupting the offence decision-chain, could be a valuable addition to crime prevention strategies. Additionally, offender rehabilitation initiatives could be enhanced by the inclusion of strategies to increase offender awareness of the (unconscious) cues that trigger offence scripts, and to replace anti-social with more pro-social responses. However, the application of the expertise paradigm to offending behavior is in the early stages. The current study utilizes a VR-enhanced experimental approach to add to current understanding of the role of expertise in offending decision-making and the development of proficiency in residential burglary.

Using VR to investigate burglary

Considering the automatic and unconscious nature of domain-specific decision-making in expertise, there are inherent difficulties in methodologies requiring offenders to reflect on these cognitive processes (Nee, 2015). Additionally, it is dangerous and unethical to observe them as they undertake an offence. Accordingly, there has been a move towards the development of increasingly sophisticated experimental methods, specifically the use of virtual reality (VR) as a proxy for real life behavior (e.g., Nee et al., 2015; Nee at al., 2019; Van Gelder et al., 2017). In a series of studies, simulated environments have been shown to produce behavior comparable to that observed in a genuine burglary (Nee et al., 2015), to elicit physiological reactions as would be anticipated in a real-life burglary (Van Gelder et al., 2017), and to enable the accurate observation and recording of offence related behavior as it happens (Nee et al., 2019).

To date, the research using VR technology provides strong support for the superior cue recognition, schema activation and automaticity predicted in the expertise paradigm (e.g., Nee et al., 2015; Nee et al., 2019; Van Gelder et al., 2017). Moving forward, the current research looks to extend the existing research by examining in greater depth the impact of expertise on behavior and decision-making between burglars at different points of their criminal careers. The aim, therefore, is to add depth to our understanding of the development of dysfunctional expertise over time, in order to assess its impact on continuation and specialization in residential burglary.

The current study used a virtual environment (VE) to examine the way that younger compared to older burglars conducted a residential burglary to assess the impact of experience at different stages of the criminal career had on behavior and decision-making. Research on the development of expertise in younger and older offenders is in its infancy, and a recent study by Meenaghan et al. (2020) suggests variations in motivations for the offence within burglar groups. As such, a comparison by age is utilized as a starting point for understanding skill acquisition in residental burglary. In line with the research presented above, burglars with lengthier burglary careers (henceforth “older burglars”/OBs) were expected to demonstrate more effective and efficient scoping and target selection decisions than those with shorter careers (henceforth “younger burglars”/YBs). This would be evidenced in the time taken to select a property in relation to the distance travelled around the target neighborhood; to be more likely to select an end-of-terrace property; and to enter the target through a rear entry point (Hypothesis 1). OBs were predicted to conduct a more effective search than YBs, assessed using a combination of time and distance travelled inside the property as well as a focus on the “high-value” areas of the property (Hypothesis 2). OBs were also anticipated to be more discerning in the items stolen compared to YBs, focusing on smaller, portable goods with higher value, and lesser weight and volume (Hypothesis 3). Finally, based on Nee et al. (2019), OBs were expected to be more likely to locate hidden items and be more willing to steal goods that are harder to sell or convert into desired items than YBs (Hypothesis 4).

Method

Design

The research used a mixed-methods approach that included a between-subjects experimental design. Age of incarceration (20years and under vs. 21years plus) was the only between-subjects factor. Scoping time and distance, search pattern, and items stolen were the dependent variables, all logged by a computer program.

Participants

86 individuals (M_{age} = 28.51years, SD = 11.23) participated in the study. All were male, reflecting the high proportion of male burglars reported in crime statistics (84%, according to Crime Survey for England and Wales statistics, 2020). All participants were serving sentences in adult prisons or Young Offender Institutions (YOIs) in the UK. In accordance with conditions set by Her Majesty’s Prison and Probation Service (HMPPS), participants were required to have previous or current convictions for burglary. Previous research (Bennett & Wright, 1984; Nee & Meenaghan, 2006; Wright & Decker, 1994) suggests that official offence history may not be the most reliable indicator of experience in burglary, as many experienced burglars do not have extensive burglary convictions. Accordingly, experience was also assessed using participant disclosures. Inclusion decisions were agreed by three members of the research team based on estimated total lifetime burglaries and quality and quantity of knowledge about burglary (in line with skills and knowledge identified in previous samples, e.g., Clare, 2011; Cromwell et al., 1991; Nee & Taylor, 2000; Wright & Decker, 1994). Eighteen participants were excluded, two because of software failure and 16 due to insufficient experience (n=9 estimated fewer than 5 lifetime burglaries, n=1 had experience limited to commercial burglary, and n=6 denied burglary experience). These individuals were felt to align more with the “naivettes” of (Nee et al., 2019), and therefore were excluded, leaving n=68 participants with an age range of 18 to 61years (M = 29.00, SD = 11.68).

Previous research suggests that most burglars have their first burglary experience at around 13 years of age (Decker et al., 1993; Farrington et al., 2014). HMPPS approval granted for the current research did not extend to establishments holding those under the age of 18years. As such, the current research did not capture those at the very early stages of burglary experience — all participants had experienced the opportunity to develop some level of expertise. The mean age of initiation into burglary for the sample was 15.52years (SD = 4.48; range = 8–37). Only 6 participants had their first burglary experience as an adult (over 21years). Seventy-eight percent of the sample indicated that they participated in burglary regularly up until their most recent incarceration.

To assess the impact of developing expertise at different points of the criminal career, the sample was divided by age. Estimates of lifetime burglaries proved to be an ineffective measure of experience as participants were unwilling or unable to provide reliable numbers, preferring to estimate numbers of burglaries per day/week for an extended period. Rough calculations using this information, however, showed that both groups estimated over 200 lifetime burglaries, indicating that all participants could be considered to be "experienced" in burglary. OBs did estimate higher numbers (268 lifetime burglaries) than YBs (201 lifetime burglaries). As such, it is noted that the key difference between the groups is age and relatedly, the length of their criminal career. Taking into consideration the similarities between the two groups in age of initiation, estimated burglaries per day/week/month and continued participation in burglary to the point of incarceration, this can be tentatively assumed to suggest increased experience in the OBs compared to the YBs. Importantly, recent research (Meenaghan et al., 2020) indicates that younger (adolescent) burglars' decision-making may be influenced by other age-related factors alongside expertise, including the influence of others and the desire for excitement. Similarly, higher levels of impulsivity in younger offenders (Nee & Ioannou, 2018) may impact on decision-making. A valuable focus of enquiry would be to assess these factors alongside the early observations of Logie et al. (1992) which demonstrated that young burglars accrue experience relatively quickly. The age-based division of the sample used in the current research allows for investigation of the role that expertise plays in experienced young burglars compared to experienced adult burglars, with implications for further understanding the development of expertise alongside other influential factors associated with maturation.

Age of incarceration was implemented to divide the sample into "younger" and "older" burglars due to the inclusion of one YOI that held long-sentenced prisoners. These participants were felt to align more with the younger participants, as they had not had the opportunity to offend or build up more expertise during their lengthy incarceration. The sample consisted of 36 YBs (20years or younger at incarceration; M_{age} = 20.31; SD = 1.45) and 32 OBs (21years plus at incarceration; M_{age} = 39.19 years; SD = 9.93).

Materials

The virtual environment

The virtual environment (adapted from the simulation used by Nee et al., 2019) depicted a street of five terraced properties, developed using the Unity Pro 4.2 engine.

A laptop-based simulation was chosen in place of fully immersive VR (i.e., a head mounted display (HMD)) because of restrictions on the use of technology in UK prisons at the time. Nonetheless, previous research (Nee et al., 2019) demonstrated high levels of immersion in a burglary task using comparable technology. The properties could be accessed through the front door, or via an alleyway that enabled access to the rear. For experimental control, the interiors of the five properties were identical, with only minor differences to the exterior of the properties (e.g., blinds up or down) to improve realism. The ground floor consisted of a hallway, kitchen, living room, and dining area. A master bedroom, nursery, study, and bathroom were located on the first floor, and an attic floor consisted of a games room and a third (teenager's) bedroom. "Valuable" items, identified as commonly targeted in burglary by previous research (e.g., Bennett & Wright, 1984; Nee & Meenaghan, 2006; Nee et al., 2015; Wright & Decker, 1994), were distributed alongside other items (food, books) in locations consistent with a typical home. Some items were placed in clear sight, while others were hidden (for example, a tablet in a rucksack). Participants were able to "steal" all the items, valuable or otherwise. Doors, cupboards and drawers could be opened, and immersion was improved using headphones, through which background sounds such as birds singing and cars passing by could be heard. Participant movements and interactions (i.e., distance travelled, time spent in different areas, items stolen) were recorded by the computer simulation, and participant vocalizations (during the virtual burglary, and in subsequent interview) were recorded using a digital voice recorder.

Procedure

Ethical approval was gained through the lead researchers' university Research Ethics Committee. Approval for the research to be conducted in HMP/YOIs was obtained through HMPPS in the UK. Eligible participants were identified by prison staff and were provided with information sheets prior to consenting to take part. These were read out loud to reduce literacy issues, and anonymity of data was assured. All consenting participants completed data collection regardless of level of burglary experience. Those without sufficient experience were later excluded from analysis.

After gaining consent, demographic data were collected. Participants were then instructed on the use of the virtual environment (VE) and asked to "think aloud" as they completed the burglary task. They were asked to approach the task as if it were a real burglary. They could spend as much time as they liked on the task but should bear in mind that they could be disturbed, or that the police might arrive. The virtual burglary task was followed by the semi-structured interview (approximately 45 min) which explored the undertaking of the virtual burglary and issues arising during the "think aloud" process. The key qualitative findings from the interviews are reported in Meenaghan et al. (2020), but for the purpose of the current research, relevant illustrative quotes are reported in relation to the salient quantitative findings. All participants were fully debriefed and thanked for their time on completion of the study. Participants were not rewarded for participating in line with ethical guidelines.

Coding

Items stolen were categorized according to their value, weight and volume. Three categories were created: high-value, mid-value, and low-value. High-value goods included items such as wallets, cash, passports, jewelry, identity documents, tablets, and phones. Mid-value goods included the larger electronic goods (laptops, games consoles, TVs). Low-value items included less valuable electrical items such as microwaves, also toys, food, and books.

Results

A multivariate analysis of variance (MANOVA) was conducted with age of incarceration (20years and under [YB] vs. 21years plus [OB]) as the between subjects-factor. Scoping time and distance (time taken to entry of target, distance travelled to entry of target), search pattern (total time (s), total distance (m), and time and distance on each floor of the property), and items stolen (total goods (n), total weight (g), total volume (l), and total value (€) were the dependent variables. A significant multivariate main effect was obtained for age of incarceration, Wilks' $\lambda = 0.50$, $F(16, 50) = 3.18$, $p = 0.001$, ${\eta_p}^2 = 0.50$. All univariate effects are reported below in line with each hypothesis.

Scoping the neighborhood, target selection, and entry to the property

It sounds weird, but you just, kind of know, when you see the house… I don't know how to explain it, I just feel like that's the one… PPT037(YB).

In order to investigate scoping and target selection decisions (Hypothesis 1), the univariate effects for time taken and distance travelled prior to target selection were examined.

YB scoped the VE and made their target selection choice significantly more quickly (M =76.69, SD = 13.03) than OB (M = 132.32, SD = 14.04) $F(1, 65) = 8.43$, $p = 0.005$, ${\eta_p}^2 = 0.65$, $d = 4.11$. No significant difference was found between the groups (YB M = 93.39, SD = 9.89; OB (M = 104.03, SD = 10.65) in terms of the distance travelled in this time, $F(1,65) = 0.54$, $p = 0.467$, ${\eta_p}^2 = 0.01$, $d = 1.04$.

Chi-squared analyses were conducted on target chosen (end-of-terrace vs. mid-terrace property) and entry point (rear vs. front door) between YB and OB. No significant difference was found in the property selected (χ^2 (1, N = 67) = 1.29, $p = 0.256$, $\phi = 0.26$, though nearly three-quarters of OB (74%) as opposed to 61% of YB chose an end-of-terrace property) showing a descriptive trend in line with expectations about experience increasing with age. Notably, the most popular house was House 1, the furthest away and the only house with an alarm.

Alarms don't bother me, do you know how many times I've walked past houses on streets and the alarms are belting out and no-one gives a shit, unless you're seen. PPT028(AB)

Regarding the point of entry (χ^2 (1, N = 67) = 0.31, p = 0.762, ϕ = 0.76); the overwhelming majority of both groups (81% of older, 75% of young burglars) gained access through a rear entrance. In sum, there was little support for Hypothesis 1, which predicted differences between the groups in terms of efficiency.

Searching the property

Hypothesis 2 predicted a more efficient and effective search of the property by OB compared to YB. Analysis of the univariate effects for time spent within and navigation around the property revealed significant differences between the two groups. The OB spent significantly longer in the property (on average, 6.5min) than the YB (5mins) (Table 1). YBs, however, travelled significantly further in the property as a whole than OBs (152.64m vs. 119.09m on average, Table 2) as well as on the ground floor (72.27m compared to 48.66m), and first floor (68.93m compared to 52.67m, see Table 2). Time spent between the two groups was not significant (ground floor, $F(1, 65) = 3.28$, $p = 0.075$, $\eta_p^2 = 0.05$, $d = 0.45$; first floor, $F(1, 65) = 3.72$, $p = 0.058$, $\eta_p^2 = 0.05$, $d = 0.49$, Table 1). As such, both groups spent a similar amount of time on the ground and first floors, but the search process employed by the younger burglars covered a greater distance during this time. No significant differences were found for either time spent (F (1, 65)= 1.03, $p = 0.315$, $\eta_p^2 = 0.02$, d = 0.25), or distance travelled ($F(1, 65) = 2.80$, $p = 0.099$, $\eta_p^2 = 0.04$, $d = 0.44$) on the attic floor between the two groups.

Items stolen

> *Take…the smaller objects, you can quickly put in your pocket… there's no point picking up a big heavy TV, coz you can't run with someone chasing you.* PPT012(OB)

Hypothesis 3 predicted a more considered choice of items to steal by OBs compared to YBs. The findings supported this hypothesis, in that YBs were more likely (M = 2.89, SD = 5.24) than OBs (M = 1.48, SD = 4.20) to target the "mid-value" goods (larger electrical items), $F(1, 65) = 6.30$, $p = 0.015$, $\eta_p^2 = 0.09$, $d = 3.56$ (see Table 3). The average "haul" (i.e., total value of goods stolen) between the groups was notably different, with YBs stealing items worth €515.90 more than the OBs. This did not reach statistical significance, $F(1, 67) = 2.49$, $p = 0.119$, but it did reflect the findings of Nee et al. (2019) in which comparison groups stole a more valuable haul of goods than experienced burglars by targeting a greater (unrealistic) number of large, bulkier, less concealable goods, while burglars focused more on smaller, more lucrative, market-oriented items. Similarly, the current analysis indicated that the YBs stole items with a greater weight (36.8g compared to 19.01g by OBs) and volume (208.18L compared to 93.59L) (see Table 3). In line with Nee et al.'s (2019) findings (which indicated a sliding scale in number of items stolen, with non-burglars stealing more items than non-burglar offenders, who in turn stole more than experienced burglars), the YBs also stole a greater number of items than

Table 1 Means (M), standard deviations (SD), and confidence intervals (CIs) for time (s) for between subjects' analysis

	Ground floor *M* *(SD) 95% CI*	First floor *M* *(SD) 95% CI*	Attic *M* *(SD) 95% CI*	Total *M* *(SD) 95% CI*
Younger burglars $N = 36$	112.48 (50.73) 90.30–134.67	132.68 (55.64) 101.41–163.94	56.05 (35.48) 40.92–71.18	299.80 (29.21) 241.47–358.13
Older burglars $N = 31$	142.04 (81.38) 118.14–165.95	177.05 (124.52) 143.36–210.75	67.34 (54.85) 51.03–83.64	389.34 (31.47) 326.48–452.20

Table 2 Means (M), standard deviations (SD), and confidence intervals (CIs) for distance (m) for between subjects' analysis

	Ground floor *M* (*SD) 95% CI*	First floor *M* (*SD) 95% CI*	Attic *M* (*SD) 95% CI*	Total *M* (*SD) 95% CI*
Younger burglars *N* = 36	72.27 (42.01) 60.83–83.70	68.93 (36.52) 58.73–79.13	25.08 (21.86) 19.15–31.02	152.64 (52.36) 136.01–169.28
Older burglars *N* = 31	48.66 (22.34) 36.33–60.98	52.67 (21.85) 41.68–63.65	17.77 (11.47) 11.37–24.17	119.09 (47.08) 101.16–137.02

OBs (on average 3 more). However, there was no difference in the number of high-value, $F(1,65) = 0.004$, $p = 0.953$, $\eta_p^2 = 0.00$, $d = 0.08$ or low value, $F(1,65) = 0.004$, $p = 0.948$, $\eta_p^2 = 0.00$, $d = 0.09$, goods stolen between the groups (Table 4).

It was predicted in Hypothesis 4 that OBs would be more likely to find hidden items. However, an independent samples *t* test revealed no difference between the number of hidden items found by the two groups, $t(67) = 0.14$, $p = 0.710$, $\eta_p^2 = 0.01$, $d = 0.09$ (see Table 4). Therefore, the findings did not support this final hypothesis.

Discussion

The current study aimed to extend the application of an expertise paradigm to explain offending behavior, by examining skills and knowledge at different stages of the criminal career. Compelling evidence exists for the automatic processing of environmental cues, and the use of cognitive scripts to assist in the commission of a burglary (Nee et al., 2015; Nee et al., 2019). Additionally, evidence for a hierarchy of expertise between groups with differing levels of burglary knowledge (e.g., non-offenders, to non-burglar offenders, to experienced burglars) has also been established (e.g., Clare, 2011; Nee et al., 2015; Nee et al., 2019). Experimental work (e.g., Logie et al., 1992; Wright et al., 1995) indicates a sliding scale of proficiency in the recognition and use of burglary-related cues in decision-making. Householders, for example, demonstrate limited skill, followed by police officers, then non-burglar offenders, and finally, young burglars, who show the most accomplished recognition and processing of burglary-relevant environmental cues (Logie et al., 1992). Similarly, experienced burglars show greater procedural and perceptual knowledge compared to novice burglars (Clare, 2011). Nonetheless, further research is required to establish how the progression of skill acquisition influences decision-making and behavior. Specifically, whether increasing experience results in ongoing development of expertise, or whether skills and knowledge plateau at a level sufficient for successful completion of the offence. Understanding the role that expertise plays at different stages of the criminal career offers the potential for more targeted interventions that consider the cognitions and emotions associated with the offence, as well as crime prevention strategies that monopolize on the limitations of expert

Table 3 Means (M), standard deviations (SD) and confidence intervals (CIs) for weight (g), value (€), volume (L), and range of goods stolen

	Weight (g) *M* (*SD*) *95% CI*	Value (€) *M* (*SD*) *95% CI*	Volume (L) *M* (*SD*) *95% CI*	Total *M* (*SD*) *95% CI*
Younger burglars *N*=36	36.89 (30.78) 27.83–45.94	2195.75 (1377.68) 1751.99–2639.51	208.18 (181.40) 155.56–260.80	12.94 (7.50) 10.53–15.36
Older burglars *N*=31	19.01 (22.31) 9.25–28.76	1679.85 (1279.30) 1201.64–2158.05	93.59 (125.97) 36.88–150.29	10.38 (6.95) 7.79–12.99

Table 4 Means (M), standard deviations (SD), and confidence intervals (CIs) for types of goods stolen

	Low-level *M* (*SD) 95% CI*	Mid-level *M* (*SD) 95% CI*	High-level *M* (*SD) 95% CI*	Hidden *M* (*SD) 95% CI*
Younger burglars *N*=36	1.61 (2.20) .97–2.25	2.89 (5.24) 2.13–3.65	4.47 (1.96) 3.47–5.47	1.78 (1.74) 1.19–2.36
Older burglars *N*=31	1.58 (2.54) .89–2.27	1.48 (4.20) .66–2.30	4.52 (1.85) 3.44–5.59	1.93 (1.78) 1.32–2.56

decision-making described above (Chi, 2006; Dror et al., 2011; Woollett & Maguire, 2010). The current research provides an experimental comparison of the completion of a virtual burglary by younger and older experienced burglars to add to the existing but limited evidence for varying levels of proficiency in burglary decision making in burglars at different stages of their criminal careers (Clare, 2011; Logie et al., 1992).

Hypothesis one predicted that OBs would demonstrate more effective and efficient scoping and target selection decisions than YBs. Previous experimental research with burglars has consistently demonstrated skilled recognition and processing of burglary-related environmental cues (e.g., Bennett & Wright, 1984; Logie et al., 1992; Maguire & Bennett, 1982; Wright et al., 1995), a key feature of accomplished target selection. Indeed, Bennett and Wright's (1984) "searcher" typology is defined by the burglar's use of previously-learned cues to vulnerability of target property. Similarly, Cromwell et al. (1991) described heuristic decision-making based on the assessment of environmental cues in target selection. Scanning of the environment has been demonstrated to be a function of practice and learning, up to the point of becoming automatic in expert burglars (e.g., Cromwell et al., 1991; Taylor & Nee, 1988; Wright & Decker, 1994). Thus, it was anticipated that OBs would make their target selection decisions in a shorter time frame, using a more efficient route around the neighborhood than YBs. In contrast to this, the current findings indicated that YBs spent less time scoping the neighborhood than OBs; however, both groups covered a similar distance before making their target selection decisions. In other words, YBs travelled the same distance through the neighborhood, but in a quicker time, suggesting that burglary experience of YBs in this sample was sufficient to develop the use of effective route heuristics (as anticipated from the dysfunctional expertise model; Nee 2015). However, the speedier time to entry observed in the YBs could indicate age-related influences on cognitive processing, specifically related to higher impulsivity (Nee & Ioannou, 2018) and the increased desire to engage in risky and thrill-seeking activities during adolescence (Nee & Ioannou, 2018). The longer time frame before target selection observed in OBs could be an indication of increased confidence and self-efficacy in exploring unfamiliar territory (Clare, 2011), alongside a desire to avoid drawing attention or to look out of place (Cromwell et al., 1991; Rengert & Wasilchick, 1985). In line with Bennett and Wright's (1984) assumption of phased planning in relation to experience, Van Sintemaartensdijk et al. (2022) proposed that more experienced burglars may have a greater awareness of guardianship in an environment, and thus engage in more time-consuming checking for safety before progressing an offence. When considering guardianship (the presence of others, a key situational feature associated with deterrence; Bennett & Wright, 1984; Wright et al., 1995), it is also worth considering the age-related tendency to switch from working in pairs or groups during adolescence, to lone offending in adulthood (Carrington, 2002; Piquero et al., 2007). The participants in the current research supported this in their self-reported offending patterns (82% of older burglars compared to 29% of young burglars always or usually worked alone). The somewhat slower target selection decisions may reflect the fact that a lone adult offender is less likely to be noted by potential guardians (neighbors or householders; Cohen & Felson, 1979) than a group of youths, who may be more motivated to make faster decisions to avoid drawing attention to themselves. As noted by van Sintemaartensdijk et al. (2022), competency may impact risk perceptions in relation to guardianship, and in turn, the behavior and decisions made in relation to the burglary offence.

> *If you've got two adults, two males walking up and down the street it looks a little bit more suspect… there's more chance of getting caught before you've even done anything*. PPT030(OB)

The findings of the current research may also provide additional nuance to the proposed sliding scale of expertise (Clare, 2011; Logie et al., 1992; Wright et al., 1995), and to Nee et al.'s (2019) discussion of naivettes versus novices. As noted above, mainstream cognitive literature on expertise differentiates between those with total ignorance of a field ("naivettes") and those lacking in experience ("novices") (Chi, 2006). It is possible that the YBs' skills tend more toward the novice end of the spectrum. They have had the opportunity to develop, through prior learning, the use of effective route heuristics, but have not reached the level of skill required for confidence and self-assurance in the task (Clare, 2011). This perspective is supported by the observation that Nee et al.'s (2019) non-offender participants travelled a significantly shorter distance before selecting a target than experienced burglars, indicating a less thorough assessment of the environment, and placing them on the "naivette" end of the scale. Additional research is required to fully understand the role that the various components of expertise play on decision-making as the burglar progresses along the spectrum of proficiency. However, one explanation of the current findings that aligns with previous research is that, as cognitive schema develop, fewer cues are used in target selection, predicting the opportunity for faster decision-making with experience (Macintyre & Wortley, 2014; Snook et al., 2011).

Additional evidence for the hierarchy of expertise was observed in target selection. All participants, regardless of length of criminal career, showed a preference for end-of-terrace properties and rear entry-points. Knowledge of the relative safety of this approach was not present in Nee et al.'s (2019) non-offenders, or non-burglar offenders, suggesting this knowledge is specific to individuals with experience of committing burglary. The YBs in the current sample showed procedural knowledge of the "safest" property and entry point, therefore had the foundations of target selection competency. Interestingly, the house with the alarm was most targeted, replicating the findings of Nee et al. (2019), and providing additional support for the paradoxical findings of Tseloni et al. (2017). Together, these indicate that alarms may be relatively ineffective in deterring experienced burglars, possibly a result of adjustments to the cost-benefit analysis resulting from experience.

The second hypothesis predicted a more effective and efficient search of the property by OBs. As demonstrated by Wright and Decker (1994), detailed cognitive scripts allow the experienced burglar to navigate a target property in such way to minimize risk and maximize gain. In the current research, both age groups demonstrated script-like knowledge of the likely location of valuable goods (the first floor, followed by the ground floor), but the OBs located desirable items more efficiently, travelling a significantly shorter distance in the property as a whole, as well as the ground and first floors individually. Their automatic, script-like knowledge, based on prior learning of the likely location of valuable, easily portable goods resulted in a more focused (but not quicker) search. Nee et al. (2019) observed a similar effect, with non-offenders conducting a faster search than burglars and non-burglar offenders, and concluded that this faster search reflected a more chaotic and unrealistic burglary. The search patterns observed in the current study support a hierarchy of expertise, with YBs demonstrating knowledge of the likely location of valuable items, but still requiring a more extensive search than OBs.

As noted above, developing expertise brings with it increased confidence (Clare, 2011). Experience may enhance understanding of the likely movements of householders, and the amount of time that can be safely spent in the property to conduct a thorough search. Accordingly, more experienced offenders can select a property with relative confidence that it will be empty for a predictable amount of time. A more measured, less chaotic approach to the search is therefore possible, with the additional bonus of extending the timescale for detection and getaway:

> *I'd go into the bedrooms, coz that's where people hide their jewelry… I'd go through the drawers, I'd lift the mattresses... literally search everywhere in the bedroom, I always keep it nice and tidy… I'm not smashing everything neither… that rings their alarms… when you come home, your house looks intact, no big TVs been stolen nothing... you ain't gonna go and check your money straight away.* PPT 009(OB)

The third hypothesis predicted that OBs would be more discerning in the types of goods stolen, reflecting Clare's (2011) identification of superior recognition of higher value items by experienced compared to novice burglars. No significant difference was identified in the value of items stolen; however, the overall weight and volume was significantly higher for YBs. Nee et al. (2019) demonstrated that novices stole a higher total value of goods than experienced burglars during a virtual burglary, but that the goods stolen were unrealistic in terms of weight and volume (removing the goods would be problematic and would attract unwanted attention). In the current research, YBs aligned more closely with OBs in the value of their overall haul (the difference between younger and older burglars was less extreme than between previous burglar and non-burglar samples; Nee et al. 2019); however, OBs demonstrated more developed expertise in their avoidance of bulky electrical goods. While these goods held inherent value (confirmed by the fact these were attractive to

YBs), for the OBs, the potential gain was not worth the risk of being seen carrying such items.

> *I don't wanna be carrying stuff like TVs and that, with that, I could just have a rucksack, fling everything in that… and I'm gone*. PPT009(OB)

It is worth pointing out however, that the value of different types of goods may be subjective and age-related, with electrical items possibly holding more value for YBs compared to OBs. In addition, there may be practical issues influencing the selection of goods, such as the available opportunities for disposal of goods and demand for certain items in the burglars' network. Lastly, the willingness to consider more bulky items by the YBs may be related to the above-mentioned tendency to work in pairs or groups, and also the tendency toward more risky decisions based on immediacy of reward.

> *Yeah, I was coming out of a property with bags, with 2 other people, Yeah, and obviously we looked dodgy carrying all these big bags, and... get pulled over, and took it from there.* PPT40 (YB)

The final hypothesis predicted that YBs would be less likely to find hidden items than OBs. This was not supported by the findings, indicating that the YBs had developed some level of procedural knowledge regarding the likely location of concealed items, supporting the proposition that elements of expertise develop early on in experience (Logie et al., 1992).

The current research used an experimental approach to observe and record burglary-related behavior in younger and older burglars. It provided further evidence of skills and knowledge that suggest cognitive processes in line with the model of dysfunctional expertise (Nee & Ward, 2015), also that these skills start to develop very early in the burglary "career". Perhaps most noteworthy, was the unexpected finding that both groups demonstrated a significant level of expertise, regardless of the length of their criminal career. All of the sample demonstrated procedural and perceptual knowledge that enabled them to execute the burglary with a level of efficiency and effectiveness. Older burglars appeared to demonstrate a somewhat more nuanced level of knowledge and skill than younger burglars, but only in certain areas (a more targeted search of the property, and a preference for easily concealed goods over the — potentially more risky — larger electrical items). This supports the proposed continuum of expertise, indicating that expertise is more developed as a result of increased practice and learning, perhaps as a function of number of offences completed rather than solely of age. As such, we provide further backing for the inclusion of expertise as a key factor in understanding offender decision-making, with the potential to add explanatory power to cognitive models of offending.

The age-based comparison of offender expertise provides valuable insight for the practical application (crime prevention and intervention) of a model of dysfunctional expertise. While understanding the key cognitive processes that influence the decision-making of experienced offenders allows for deeper understanding of offending behavior, this must be considered alongside other age-related factors that may have an important influence on the commission of the offence. Working with accomplices, for example, will have inevitable consequences for the way the burglary takes place, simply because it involves more than one person entering and searching the property. It also offers the opportunity to steal a greater number of items. In addition, there is evidence to suggest that burglars may take greater risk when working in groups than when working alone. Experienced, active burglars in Cromwell et al.'s (1991) p. 68 research reported a tendency to "psych" each other up, also that they felt braver when part of a group than when alone. These effects may override the influence of expertise-driven decision-making. The diminishing importance of the influence of peers and accomplices (and with it, increased lone offending) as the offender enters adulthood coincides with more developed expertise (and therefore, automaticity), proliferating engagement in burglary. This finding aligns with that of recent qualitative research (Meenaghan et al., 2020), which indicated a greater influence of expertise in adult offenders following a reduction in the experience of psychological reward (thrill, excitement), and adding support to the proposition that expertise plays an important role in the proliferation of, and specialization in burglary. Our findings suggest that, like the young offenders in Logie et al.'s (1992) sample, expertise builds up very quickly even in very young offenders.

Limitations

While the current research provides the opportunity to come closer to observing real-life offending behavior, thus addressing some of the limitations of previous offender-based research, conducting a virtual burglary is still far removed from committing a real burglary. Nonetheless, this, alongside other VR-based burglary research (e.g., Nee et al., 2015; Nee et al., 2019; Van Gelder et al., 2017; van Sintemaartensdijk et al., 2022), promotes the potential for the development of more immersive (e.g., using VR headsets) and more varied simulations. The development of a simulation that enabled two (or more) participants to complete a burglary together would provide valuable insight into expertise and co-offending.

We also acknowledge criticism directed toward the use of prison-based samples, namely the targeting of "failed" burglars (Cromwell et al., 1991; Wright & Decker, 1994). All participants included in analysis had sufficient experience of "successful" offending (burglaries for which they had not been caught) to allay some concern regarding capabilities as a burglar. Previous research using both active and incarcerated offenders demonstrated considerable similarities in terms of the assessment of environmental cues and the search of the property (Copes & Hochstetler, 2010).

The current research was exploratory in nature and while it indicated expertise in both younger and older burglars, it did not include a non-burglar sample as a comparison group, therefore relied on knowledge from previous, non-burglar samples (e.g., Nee et al., 2019). It is also noted that the use of index offence, and the division of the sample by age may not be the most reflective measures of experience. As a result of access restrictions, it was not possible to include a sample of burglars at the very early stages of their career. Future research would benefit from the inclusion of much younger participants (to assess very early expertise), and the inclusion of participants who identify as experienced burglars, but who do not necessarily have numerous convictions for burglary. Additionally, given the importance that number of offences completed as a measure of expertise seems to have from our findings, future research would profit from a more reliable indicator of experience (i.e., a more accurate measure of number of burglaries completed) to more sensitively assess the relationship between increasing experience and expertise development.

Implications

The current research provides further evidence of expertise in experienced burglars, even from a relatively young age, adding weight to the crime prevention and rehabilitation opportunities identified by Nee and Ward (2015). Importantly, the study highlighted the many similarities between the two groups. Both groups demonstrated effective route heuristics in the navigation of the neighborhood and made skilled target selection and entry decisions. Additionally, both groups showed understanding of the likely location of valuable goods, supporting existing literature on the development of skills and expertise relatively early on in the criminal career. As such, additional support is provided for interventions that understand the implications of expertise on decision-making. For younger burglars, it is pertinent to combine this with consideration of the impact of increased risk taking and thrill seeking (Meenaghan et al., 2020) and the lack of effortful control (Nee & Ioannou, 2018); however, suggested initiatives include capitalizing on the fragile nature of expertise by incorporating unpredicted elements into the environment to trigger deliberative thinking in place of automatic thinking (Nee & Ward, 2015). Additionally, interventions aimed at increasing the offenders' awareness of pre-conscious scanning and the role of automatic schema may be valuable from the early stages of criminal involvement. Vernham and Nee (2016) describe how the capacity to recognize competencies in offending can be used, in motivated offenders, to comprehend alternative pro-social decisions and promote desistance. The observation of characteristics of expertise in young offenders is particularly valuable considering the key role that early intervention plays in current youth justice (Goldson, 2000). Meenaghan et al. (2020) discuss the role that emotion (specifically, the desire for the thrill of the offence) plays in encouraging repeated offending in younger burglars, in turn promoting the development of expertise through practiced learning. As such, a more comprehensive understanding of the strength of the influence of automaticity and pre-conscious decision-making, alongside peer influence and the experience of affective reward, during the early stages of the criminal career is critical for targeting the key motivating factors according to individual offenders' experience. From a crime prevention perspective, the finding that decision-making in burglary may be influenced by the components of expertise in even young burglars indicates the value of crime prevention measures designed to disrupt the automatic triggering and playing out of anti-social cognitive scripts. Unusual layouts, unexpected barriers to movement around the neighborhood, and unanticipated guardianship are such examples (Nee et al., 2019). The use of simulated environments in research with burglars of varying levels of experience would allow for the testing of such intervention methods. This approach offers the benefit of manipulation and experimental control. As such, specific crime prevention initiative can be tested with burglars of different ages, with different experience, and importantly from the findings of the current research, when "burgling" alone or in pairs or groups.

The research presented here continues to demonstrate the worth of using VR to understand offender decision-making and behavior. In addition to replicating previous findings relating to expertise and automaticity in offender decision-making, it shows that this approach is successful in differentiating between the behavior of those with "early" versus "developed" expertise. We can, therefore, be confident that the use of a VE provides data that is discriminatory within offence type, a benefit that further justifies its use with more diverse types of offending. The expertise paradigm has been extended to other crimes such as street robbery (Topalli, 2006), sexual offending (Bourke et al., 2012) and firesetting (Butler & Gannon, 2015). There is also scope for future research investigating, for example, specialist burglars compared to those with more diverse offending patterns. The use of VR addresses issues arising as a result of limitations of memory common to interview-based research (e.g., the deliberate or unintentional misreporting of data, Kahneman, 2011; Nee, 2010; Van Gelder et al., 2017; Wilson & Bar-Anan, 2008). This is particularly important when investigating cognitions that are not subject to conscious awareness (as observed in expert decision-making). The use of VR not only enables the observation and recording of offending behavior in a context that goes some way to replicating "real-life", it also enables the elicitation of automatic verbal reports as the offender actually completes the "offence". Finally, it reduces the impact of errors of reporting, as individuals can reflect on an event that has just happened, rather than on one that occurred weeks or months or even years in the past.

Conclusion

The current research compared how burglars at different stages of their criminal career conducted a residential burglary in VR. The findings provide support for the influence of expertise on offence-related decision-making, and for the notion that expertise continues to develop as experience accrues. The exact nature of the impact of expertise at various stages of the criminal career, and its interaction with other factors (e.g., age, influence of others, motivation, and the importance of emotional reward) requires further research; however, the current study adds valuable evidence to better understand the role that expertise plays in decision-making from very early on in the criminal career. The use of VR provides a valuable means to assess expertise within and between offending groups.

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Conflict of interest None.

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