# MODELING BURGLARS' OCCUPANCY DECISIONS: FAST AND FRUGAL OR RATIONAL AND COMPLEX?

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Modeling Burglars' Occupancy Decisions:

Fast and Frugal or Rational and Complex?

By

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Abstract

The performance of two full-information models (i.e., Dawe's rule and Franklin's rule) and a simple heuristic model (i.e., Matching heuristic) in predicting occupancy decisions by burglars was examined. Burglars ($N = 40$) were presented with photographs of 20 homes (previously coded on physical characteristics such as 'open window') and asked to infer whether or not the home was occupied. Performance of each model was measured by (a) relative accuracy – the percentage of photographs for which the models correctly predicted each burglar's occupancy decisions and (b) absolute accuracy – the percentage of photographs for which the models correctly predicted actual occupancy. In terms of relative predictions, the matching heuristic was more frugal than the other two models, using, on average, 1.08 cues in comparison to all available cues. Additionally, the matching heuristic was also the most accurate model, predicting 80% of participants' decisions accurately. When modelling the actual occupancy of residences the matching heuristic was again more frugal. While Franklin's rule was slightly more accurate than both the matching heuristic and Dawe's rule, there were no significant differences between the models based on the accuracy of their absolute predictions. Overall, it appears that a simple model of decision making is able to predict residential burglars' occupancy decisions and actual occupancy states equally as well as or better than complex models.

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## 1.0 Introduction

Determining the processes by which people make decisions has resulted in much debate within the judgement and decision making literature (Goldstein & Hogarth, 1997). On one side, rational choice theorists suggest that decision making should involve the examination, weighting, and integration of all possible cues so that optimal decisions may be reached (Edwards, 1954). On the other side, bounded rationality theorists suggest that decision making occurs within the human limitations of time, knowledge, and cognitive ability by using a limited amount of information in a non-compensatory fashion (Gigerenzer, Todd & The ABC Research Group, 1999). This debate transcends many areas, such as medicine, finance, and criminal justice. Within the criminal justice context, there has been much debate about how offenders make decisions. Some theorists have argued that offenders make choices by developing complex templates of the cues, clusters of cues, and sequences of cues that indicate potential targets in order to locate optimal targets (Brantingham & Brantingham, 1981) while others have argued that offenders use a minimal number of cues that allow them to search for targets that are simply satisfactory (Cromwell, Olson, & Avary, 1993). Ultimately, however, little is known about offenders' decision making processes and few researchers have considered the possibility that offenders may use very simple heuristics to select targets. In the current study, the extent to which complex rational models versus fast and frugal heuristic models of decision making are accurate in predicting residential burglars' decisions about whether homes are occupied or unoccupied was examined.

The following introduction is divided into two major sections. In section one, the history of the rational choice versus bounded rationality debate is summarized and examples of decision making models on each side of the debate are provided. In section two, an overview of the residential burglary literature, the importance of occupancy in the vulnerability of residences to burglary, defensible space theory as a means of linking the environment to crime risk and the processes by which burglars are hypothesized to assess potential burglary targets are reviewed. A discussion of the rationality versus bounded rationality debate as it maps onto hypotheses of residential burglars' decision making processes is also included.

1.1 *Models of Human Decision Making*

A primary, and ongoing, debate in psychology is about how humans make decisions. At the most basic level, on one side of this debate are proponents of fully rational models of decision making which involve the weighting and integration of all available cues (e.g., Anderson, 1990). On the other side of this debate are bounded rationality advocates, who claim that people use simple mental rules when attempting to make decisions (e.g., Todd & Gigerenzer, 2000).

Overall, there are three important differences between these decision making models. Firstly, fully rational models require people to use all the information that is available whereas heuristic models use only a subset of the available information. Secondly, under the fully rational models, all the information available must be weighted and then integrated while heuristic models often use only one cue in order to reach a decision. Thirdly, as a result of weighting and integration, fully rational models are compensatory because cues can cancel each other out. In contrast, heuristic models are noncompensatory; that is, once a decision has been reached using one cue, no other combination of cues can change the decision (Todd & Gigerenzer, 2000). The following review of this debate shows that the major points of contention between these models of decision making relate to these three main differences.

1.1.1 *Fully Rational Decision Making*

Rational choice theory has its origins in the work of mathematical probabilists such as Condorcet and Laplace who attempted to apply mathematics when modelling psychological and social phenomenon (Daston, 1981). The legal arena of the eighteenth century provided these theorists with natural situations in which to model decision making. For example, Laplace (1814/1951) reduced judgements of guilt or innocence in the courts to the following probabilistic question:

> Has the proof of the offence of the accused the high degree of probability necessary so that the citizens would have less reason to doubt the errors of the tribunals, if he is innocent and condemned, than they would have to fear his new crimes and those of the unfortunate ones who would be emboldened by the example of his impunity if he were guilty and acquitted?" (Laplace, 1814/1951; p. 133)

This application of mathematical models and probability theory to human decision making was considered common sense and what proper reasoning should dictate (Daston, 1981).

Similar views of humans as unboundedly rational decision makers can be found in classical economic theories such as that of economic man or *homo economicus* (Edwards, 1954). Economic man has three properties. Firstly, he is assumed to be completely informed such that he is aware of all possible courses of action as well as the outcomes associated with these courses of action. Secondly, he is also assumed to be "infinitely sensitive," meaning that he considers all available alternatives. Lastly, economic man is assumed to be fully rational because he can rank order the outcomes of his decisions and make his choices so as to maximize his expected utility by choosing the best alternative (Edwards, 1954). A number of theorists have proposed formulas, following the assumptions of economic man, which involve the integration of all available cues related to the decision at hand. These formulas (e.g., multi-attribute utility measurement, Baye's theorem and maximization of subjectively expected utility) are suggested as rules that decision makers need to apply in order to make "good" or rational decisions (Edwards & Fasolo, 2001). In more recent years, support for fully rational decision making models has been expressed in terms of on connectionist and dual process models (e.g., Barbey, & Sloman, 2007; Raghupathi, Schkade, Bapi, Levine, 1991).

1.1.2 *The Beginnings of Bounded Rationality*

Bounded rationality has it origins in the writings of Herbert Simon whose seminal work, *Models of Man*, was published in 1957. Simon rejected the theories that were being put forth, primarily in economics, to explain human decision making. In Simon's view, these models were inadequate for explaining and predicting human behaviour (Simon, 1957). He argued that their underlying assumption was that humans had rational powers of prescience and unlimited computational capacities, which completely ignored the limits of human cognition. As an alternative approach, Simon formulated the principle of bounded rationality which stated that:

> The capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for

objectively rational behaviour in the real world – or even for a reasonable approximation to such objective rationality. (p. 198)

In contrast to the prevalent theory of economic man at the time, Simon felt that it was unrealistic to assume that humans attempt to maximize their utility by reaching optimal decisions. Rather, he believed that in order to predict human decision making and behaviour we must abandon the "unrealistic assumptions of virtual omniscience and unlimited computational power" (Simon, 1957; p. 202). He believed that predicting human decision making without regard for psychological properties and limitations is an unattainable goal. Rather, Simon argued that theories of human decision making need to take into account our access to information, computational capacity, and processing speed.

Simon's model of bounded rationality also took into account the environment in which decisions were being made. Environments contain regularities that allow for further simplifications of choices so that decision makers may exploit these regularities in order to reach their decisions (Simon, 1957). Therefore, Simon's theory of bounded rationality suggests that human decision makers are "ecologically rational" because the ways in which we make decisions match the structure of the environment (Gigerenzer & Todd, 1999). A good example of ecological rationality compares the strategies used by hypothetical animals A and B given different distributions of food in their environments. If animal A's environment has food distributed in a random manner then this animal can achieve its best return by searching for food randomly. In contrast, if food in animal B's environment is associated with cues in that environment then this animal should use a search strategy that takes into account those cues.

In comparing models of adaptive behaviour in psychology to the models of rational behaviour in economics, Simon (1956) noted that the economic models were much more complex and attributed to humans a much greater capacity for obtaining and assessing information. Additionally, it appeared that the models of adaptive behaviour were better able to account for actual human behaviour. This led Simon to conclude that human decision making was not an attempt to maximize expected utilities but was more in line with what he labelled *satisficing* (Simon, 1956). Satisficing can be described as using experience to determine an expectation of how good a solution we can reasonably expect and searching until an option that reaches that expectation level is found such that we find a course of action or an option that is simply good enough (Simon, 1990). It may not be the optimal choice but it meets the requirements of the situation (Simon, 1957). Satisficing does not require estimates of probabilities or complete and consistent rankings of all the available alternatives (Simon, 1957), thus simplifying the view of human decision making processes.

### 1.1.3 *Heuristics and Biases*

Realistically, people may never be able to satisfy all of the assumptions of economic man due to the limitations of our information processing (Miller, 1956). It is difficult to think of a real world decision making situation where a decision maker would be informed completely, infinitely sensitive, and fully rational. As such, fully rational models of decision making did not appear to bounded rationality researchers to be the most appropriate method for modelling human decision making. In an attempt to empirically determine whether humans are actually fully rational decision makers researchers began conducting experiments to assess the methods by which participants reach decisions. Some of the first research in this area was conducted by Daniel Kahneman and Amos Tversky (1972). In a classic study, participants were given a small number of cues regarding a situation and then asked to judge the probability of a specific occurrence or event given these cues. For example, given that all families of six children in a city were surveyed and in 72 of these families the birth order followed the sequence female (F)–male (M)–F–M–M–F participants were then asked to estimate the number of families surveyed in which the birth order followed the sequence M–F–M–M–M–M. While both birth orders are equally as likely to occur, 82% of participants indicated that the sequence with five boys and one girl was significantly less likely than the sequence with an equal number of boys and girls. According to Kahneman and Tversky, participants appear to have judged the likelihood of the birth order in question based on its representativeness of the distribution of men and women in the general population rather than its probability of occurring. The use of such information in decision making was labelled the representativeness heuristic. Other heuristics explored through this line of research included the availability heuristic and the adjustment and anchoring heuristic (Tversky & Kahneman, 1974).

Other research in this area has used similar methods in order to assess participants' decision making. Participants were generally asked to judge the probability of an occurrence or to make a numerical prediction about the frequency of an event about which the probabilities were already known to the researchers. Participants' responses were then typically compared to the results obtained by complex, fully-rational, probabilistic models (e.g., Baye's theorem; see Kahneman & Tversky, 1972; Kahneman & Tversky, 1973; Phillips & Edwards, 1966). These studies found that humans do not appear to make decisions by following fully-rational, probabilistic models of decision making. Rather, people rely on heuristics which reduce the complex tasks of assessing probabilities and predicting values to simpler judgements (Tversky & Kahneman, 1974). In essence, people do not use all the cues that are available to them in the environment when making decisions but instead make use of heuristics or shortcuts to aid them in their decision making (Tversky & Kahneman, 1974).

The judgemental heuristics that people use to make probability assessments were found to be "quite useful" but with the caution that "sometimes they lead to severe and systematic errors" in judgement (Kahneman, Slovic, & Tversky, 1982; p. 3). These potential cognitive biases include insensitivity to prior probabilities, biases due to the ease with which people can retrieve similar instances from memory, and susceptibility to illusory correlations, among others (Tversky & Kahneman, 1974). It has been further argued that these cognitive biases are not attributable to motivational effects as participants in the above studies were often rewarded for giving correct answers (Kahneman et al., 1982).

1.1.4 *Bounded Rationality Revisited*

Work in recent years by researchers such as Gerd Gigerenzer, Peter Todd, and Mandeep Dhami, among others, has begun to challenge the idea that heuristics lead to biased and poor decision making. Specifically, while Tversky and Kahneman (1974) essentially agreed with Simon's view that people use simple cognitive processes to reach decisions, many researchers have interpreted their work as being unnecessarily negative toward the use of heuristics in decision making and human cognition as a whole. Thus, Simon's more positive view of heuristics has been revisited and elaborated upon in recent years.

Bounded rationality has now been better defined and a strong distinction has been made between bounded rationality and those models of decision making that, while appearing to be less onerous than fully rational models, are not boundedly rational. For example, according to Todd and Gigerenzer (2000), Simon's theory of bounded rationality is not to be confused with an alternative to fully rational models known as optimization under constraints. Optimization under constraints assumes that there is a limited search for cues when a decision is being made (Todd & Gigerenzer, 2000). Limited search implies that some rule must be in place to terminate the search for new cues. With optimization under constraints such stopping rules are assumed to optimize the search such that the benefits and costs of searching for each additional cue are calculated. When the costs are greater than the benefits search is stopped (Anderson & Milson, 1989). Optimization under constraints appears to be a plausible model of human decision making, however, calculating optimal stopping points can require vast amounts of knowledge and computation which may be beyond the capabilities of the human decision maker (Vriend, 1996).

Since Simon's initial work, satisficing is no longer considered to be the essence of bounded rationality. Many researchers now consider simple, fast and frugal heuristics to represent bounded rationality in its purest form (Gigerenzer & Todd, 1999). Gigerenzer (2001) suggests that human decision making abilities are analogous to an adaptive toolbox. The adaptive toolbox analogy suggests that people possess several tools for making decisions, each of which has a special design for different decision requirements, rather than a single all-purpose decision making tool. In essence, the theory of an adaptive toolbox posits that people choose the decision making tool that is most appropriate for their decision.

This view of bounded rationality through fast and frugal heuristics is based on three premises. Firstly, models of human decision making should be psychologically plausible and provide us with an understanding of how humans actually make decisions given the bounds within they must work. These strategies do not attempt to reach optimal decisions by computing the value of options or cues; rather they attempt to benefit from the organization of the environment based on past experience or a minimal amount of information gathering (Gigerenzer, 2001). Secondly, models of human decision making should be domain specific but not to the detriment of generalizability. As mentioned above, in line with this premise, the adaptive toolbox is proposed to contain specialized heuristics that are built from more general building blocks which can be combined to form a number of different heuristics. Lastly, models of human decision making must match the environment in which the decision is being made in order to be successful (i.e., they must be ecologically rational). Overall, the theory of the adaptive toolbox suggests that people use simple strategies to make quick, frugal, and accurate decisions (Gigerenzer, 2001).

Research has begun examining how bounded rationality and heuristic-led decision making may actually lead to accurate outcomes. This line of research has involved comparing the accuracy of fast and frugal heuristics to that of rational models of decision making with regard to the actual demands of the environment. That is, rational models of decision making are not held as the standard against which to measure the performance of fast and frugal heuristics and this line of research does not evaluate judgments reached by heuristics based on the laws of logic and probability theory (Todd & Gigerenzer, 2000). These differing views regarding how to measure rationality are in line with the differing definitions of rationality outlined by Manktelow (1999). According to Manktelow there is $\text{rationality}_1$ which is goal directed or "thinking, speaking, reasoning, making a decision, or acting in a way that is generally reliable and efficient for achieving one's goals." In contrast, $\text{rationality}_2$ is rule-congruent and occurs "when one has a reason for what one does sanctioned by a normative theory." (Manktelow, 1999, p. 228). Current research in the area of bounded rationality uses the $\text{rationality}_1$ definition of rationality. This research evaluates the performance of fast and frugal heuristics with respect to the demands of the environment and the final goal of the decision.

In line with the $\text{rationality}_1$ definition in the bounded rationality area, research in this area compares the performance of heuristics to the actual requirements of the environment in which decisions are being made. Two heuristics that have been studied extensively are the Take the Best heuristic and the Take the Last heuristic. The Take the Best heuristic starts with the cues that have the highest validity and searches through cues until one that discriminates between the options available is found; its basic tenet is "take the best, leave the rest." For example, the Take The Best heuristic may be used to infer which of two professors' salaries is higher. The Take The Best heuristic would search through cues such as rank, gender, years of experience and highest degree earned in order of their validity until one of these cues discriminated between the two professors. If neither rank nor gender discriminated but years of experience did then the Take The Best heuristic would infer that the professor with more years of experience has the higher salary and would not go on to consider the professors' highest degrees earned. The Take the Last heuristic will start the search for cues with the cue that discriminated between the options available in the previous problem. If this "last" cue does not discriminate, the search moves to the cue that discriminated in the second last problem, and so on.

Recent bounded rationality research has found that people rely on heuristics when attempting to reach real world decisions (e.g., Dhami, 2003; Dhami & Harries, 2001; Kee, Jenkins, McIlwaine, Patterson, Harper, & Shields, 2003). This research has also found that heuristics can in fact match, and even outperform, the accuracy of rational models of decision making while using significantly fewer cues. Such was the case with an early comparison between the Take the Best heuristic and a variety of rational inferential procedures conducted by Gigerenzer and Goldstein (1996). Each model made a decision as to which of two German cities presented had the larger population and used computer simulations of individuals who had varying degrees of recognition and cue value knowledge about German cities. The rational inference procedures performed a complete search, used all cues available, and integrated those cues to obtain a single value. The Take the Best heuristic was faster than all of the rational models because it used only a subset of the cues available (Gigerenzer & Goldstein, 1996). Additionally, the Take the Best heuristic made as many correct inferences about German city populations as one of the rational models and more than the others. Overall, due to its speed and accuracy in drawing inferences about the unknown features of a real-world environment, in comparison to a variety of rational decision making models, the Take the Best heuristic was deemed the superior model of decision making (Gigerenzer & Goldstein, 1996).

In another study, the Take the Best heuristic was compared to multiple regression and Dawe's rule over a variety of decision making environments in what was envisioned to be the "Tour de France" of decision making models (Czerlinski, Gigerenzer, & Goldstein, 1999). These environments included 20 decisions in the areas of psychology, sociology, economics, and biology, among others. For example, in the area of economics, predictions were to be made about professors' salaries based on information regarding their gender, rank, number of years in current rank, highest degree earned, and number of years since highest degree earned. The first tour was treated as a training set where the models had no previous experience with the decisions being made. The overall winner was multiple regression; it was slightly more accurate than the Take the Best heuristic with 77% correct in comparison to 75%. The second tour of this study was considered the cross-validation stage as the models now had previous experience with the decisions being made. On this cross-validation stage, all the models were less accurate than in the training stage, indicating that overfitting had occurred on the training set producing results that failed to generalize to the cross-validation set. The overall winner for this tour was the Take The Best heuristic (71%) followed by Dawe's rule (69%). It appears that overfitting occurred more with multiple regression than the other models and this model was therefore less accurate on the second tour. The frugality and simplicity of the take the best heuristic appears to have protected this model slightly, but not completely, from this overfitting problem.

Another widely studied fast and frugal heuristic is the matching heuristic. This is a flexible, noncompensatory heuristic model of human decision making (Dhami, 2003). It bases its predictions or decisions on only one cue, these decisions are not altered by the values of other cues and it can use different cues when making different decisions. An early study of the predictive ability of the matching heuristic was conducted by Dhami and Ayton (2001). This study compared the relative fits of Franklin's rule, Dawe's rule, and the matching heuristic when predicting magistrates' bail decisions. Magistrates were asked to indicate, for 41 hypothetical bail cases, whether they would grant or deny bail. It was hypothesized that the matching heuristic would adequately predict the bail decisions as magistrates work with limited time and information. The results showed that, while Franklin's rule was the best fit for the highest percentage of the sample, the matching heuristic provided the best fit on average across the sample of magistrates. It was concluded that the matching heuristic model was most appropriate for predicting the magistrates' bail decisions.

In a study designed to test the ability of different decision making models to predict the real world bail decisions rendered by judges, Dhami (2003) compared the ability of Franklin's rule to that of the matching heuristic. The information available to the judges in two courts as well as their subsequent bail decisions were recorded. Franklin's rule searched through all of the 25 available cues while the average number of cues searched by the matching heuristic was 3.0 in one court and 2.8 in another court. While the matching heuristic used fewer cues it outperformed Franklin's rule when predicting the judges decisions overall. Dhami concluded that the results of the study support the validity of simple heuristics for predicting decision making under natural conditions as the matching heuristic was both more frugal and more accurate than Franklin's rule.

A similar study by Dhami and Harries (2001) examining physicians' decisions to prescribe lipid-lowering drugs, based on a set of hypothetical patients, showed that the matching heuristic and a regression model performed equally well. Although the matching heuristic used significantly fewer cues than did the regression model in predicting the physicians decisions, there was no significant difference between the overall fit of the matching heuristic and the regression model. There was also no difference between the performances of the two models on decisions to prescribe drugs. The regression model did, however, perform slightly better than the matching heuristic at predicting the physicians' decisions not to prescribe drugs.

In a slightly more elaborate study, Kee and colleagues (2003) compared the performance of a linear logistic model to the matching heuristic on their ability to model how physicians make decisions to admit children showing asthmatic symptoms to hospital. In addition, Kee and colleagues tested the hypothesis that the performance of these two types of models would vary depending on the level of knowledge and expertise of the decision maker. It was found that the linear logistic model was better at predicting the decisions of physicians with lower levels of expertise than it was at predicting the decisions of specialists with higher levels of expertise. In contrast, the matching heuristic predicted the decisions of physicians with higher and lower levels of expertise equally well. These differences in the predictive ability of the models may have been the result of the decision making strategies of the less experienced versus more experienced physicians as well as the match between these strategies and decision making models. The novice physicians may rely more on data-driven, rule-based strategies whereas the more experienced physicians may rely on recognition and exemplar-based strategies.

Overall, however, the linear logistic model was slightly better than the matching heuristic at predicting the physicians' decisions to admit the hypothetical patients.

A more recent study conducted by Smith and Gilhooly (2006) compared the fit of a regression model to that of the matching heuristic when predicting physicians' decisions of whether or not to prescribe treatment for depression. The average fit of the logistic regression was slightly higher than the average fit of the matching heuristic. The matching heuristic did, however, achieve almost as good of a fit as the logistic regression model while using fewer cues to reach its predictions. Additionally, the matching heuristic was more flexible as it used only the necessary cues in each case. As a result, Smith and Gilhooly concluded that the matching heuristic was more psychologically plausible than the logistic regression model for predicting the decisions made by the physicians in this study.

In summary, fully rational models of decision making have long been viewed as the ideal for reaching accurate decisions. It has been found, however, that people do not always use such complex models when attempting to reach decisions. Rather, they often use simple heuristic decision making models. This use of heuristics for reaching decisions has often been viewed in a negative light because of the belief that deviations from fully rational decision making lead to inaccurate and biased decisions. In recent years this negative view has been challenged by researchers in the area of bounded rationality. This line of research has found that heuristic decision making that respects human cognitive limitations can lead to accurate decisions, even while disregarding many of the tenets of fully rational models.

## 1.2 *Residential Burglary*

The debate in the decision making literature between whether people weight and integrate all available information or use fast and frugal simple heuristics to make decisions maps very easily onto offender decision making. Specifically, for the current study, the parallel exists when looking at whether residential burglars use complex fully rational or fast and frugal methods when making decisions of occupancy.

The Criminal Code of Canada states that,

> Every one who (a) breaks and enters a place with intent to commit an indictable offence therein, (b) breaks and enters a place and commits an indictable offence therein…is guilty (d) if the offence is committed in relation to a dwelling-house, of an indictable offence and liable to imprisonment for life…" (Criminal Code of Canada)

Simply stated, a break and enter (henceforth referred to as burglary) occurs when an individual enters a residence, without the permission or consent of the owner of that residence, for the purpose of committing a crime (e.g., robbery) therein. The Criminal Code definition, however, highlights the seriousness of residential burglary as a crime. In comparison to residential burglaries, the maximum penalty for non-residential burglaries is ten years imprisonment.

Residential burglary accounts for the majority (59%) of all burglaries in Canada (Statistics Canada, 2004). The number of residential burglaries reported nationally reached its highest point in 1991 when 246,716 residential burglaries were reported, a rate of 880 per 100,000 population. The rate of residential burglaries has since decreased. In 2002, there were 162,851 residential burglaries, a rate of 518 per 100 000 population, while for the year 2006 there were approximately 150 000 reported residential burglaries (Statistics Canada, 2004; 2007).

When a burglary occurs it is quite likely to be reported to the police. Survey results have shown that of those respondents who have been the victims of a burglary 62% have reported it to the police, more than any of the other eight crimes measured in the survey including motor vehicle/parts theft and robbery (Statistics Canada, 2004). Despite the high reporting of burglaries, very few of these crimes are actually cleared by the police (Statistics Canada, 2004). In 2002, 17% of residential burglaries were cleared by police. A total of 31,297 persons were charged with all types of burglary. Of those charged, 63.3% were adult offenders while 36.7% were youth offenders and 91.4% were men while 8.6% were women (Statistics Canada, 2004).

### 1.2.1 *Physical Indicators in Burglars' Target Selection*

When attempting to determine whether a residence is a suitable target, burglars are faced with a large number of physical characteristics associated with that target residence. Correspondingly, several models of the categories of cues which burglars must assess when making occupancy decisions have been developed.

One conceptualization of the physical indicators of residential territoriality divides these indicators into four classes: (a) symbolic barriers, (b) actual barriers, (c) traces, and (d) detectability (Brown, 1985). Symbolic barriers are physical qualities that communicate the territorial concern and personal identity of the owners, actual barriers are aspects of a security system, traces are indicators of the presence or absence of residents or neighbours and, finally, detectability factors include the visual or auditory accessibility of a residence and of people near or in the residence (Brown, 1985). This model hypothesises that burglarized residences should be lacking in symbolic and actual barriers, have few traces and poor detectability.

Another widely cited model of the cues facing residential burglars selecting targets divides cues into those related to surveillability, occupancy, and accessibility (Cromwell et al., 1993). Surveillability is the extent to which neighbours and other individuals in the area can observe a residence. Occupancy cues indicate whether or not the residents are currently in the home and accessibility cues indicate the degree of difficulty to be expected when entering the residence and how well the residence is protected. A vulnerable target under this model would have few surveillability and occupancy cues but many accessibility cues.

A third framework of the cues through which residential burglars examine potential targets was proposed by Nee and Taylor (1988). The four broad categories of cues in this model are: (a) layout cues, (b) wealth cues, (c) occupancy cues, and (d) security cues. Layout cues include the type of residence and the points of access to the residence. Wealth cues include the type of décor, the physical appearance of the exterior of the home, and the presence of costly items. Occupancy cues indicate whether the residents are home and include open or closed windows and curtains or the presence or absence of cars. Finally, security cues include the presence or absence of locks, security systems, and so on (Taylor & Nee, 1988).

Although there are differences in the way the cues that residential burglars use are classified, there is a common thread within these classification systems. All three indicate that burglars consider traces of occupancy, cues indicating the probability that the occupants are home or away when assessing a target (Macdonald & Gifford, 1989). The optimal target is one where no residents are at home. In line with this, time of day is also considered to be an important cue for residential burglars as it may be used to infer whether a residence is occupied (Brantingham & Brantingham, 1993). Temporally, burglaries are usually best committed at a time when residences are most likely to be unoccupied and the routine patterns of residents help in making occupancy decisions (Brantingham & Brantingham, 1993). For burglars, time can be a very important cue as to the vulnerability of a residence as the best burglary opportunities occur at times when residences are normally unguarded (Rengert & Wasilchick, 2000). Residences are usually unoccupied during the daytime, especially in the early morning and late afternoon (Rengert & Wasilchick, 2000). This creates a temporal pattern of opportunities for residential burglars (Brantingham & Brantingham, 1993; Rengert & Wasilchick, 2000).

### 1.2.2 *Occupancy as an Indicator of Vulnerability to Burglary*

It is hypothesized that most burglars prefer to enter unoccupied residences (Bennett, 1989; Bennett & Wright, 1984; Winchester & Jackson, 1982; Wright & Logie, 1988) and try to avoid houses that appear to be occupied or inaccessible (Brown, 1985). For example, 28 out of 30 burglars in a study conducted by Cromwell and colleagues (1993) stated they would never purposely enter an occupied residence. Not only do the majority of residential burglars attempt to avoid encountering the residents of the homes they enter (Rengert & Wasilchick, 2000) but they also admit to attempting to make assessments of whether homes are occupied or unoccupied simply by observing the residence (Bennett, 1989). Overall, burglars are generally concerned with occupancy, and are anxious to avoid disturbances (Tilley, Webb, & Gregson, 1991).

The goal of avoiding residents when committing burglaries is in line with the point of view that for a crime to take place a motivated offender and an attractive target must be present while any guardians of the target must be absent (Brantingham & Brantingham, 1993; Cohen & Felson, 1979; Hough, 1987). In the case of burglaries, the absence of any guardians means that the residence should be unoccupied at the time of the offence. Therefore, the presence of guardians or occupants at a residence can be a deterrent to burglary because signs of occupancy may cause a target to be viewed less favourably. Additionally, should a burglar inadvertently enter an occupied residence, occupants may physically confront any intruders on their property (Hough, 1987).

Based on a series of interviews conducted with active urban burglars Cromwell, Olson, and Avary (1993) concluded that a burglar's choice of a particular residence is based primarily on environmental cues having immediate consequences for the offender. Occupancy cues were found to be assessed after surveillability cues and included the presence of cars, visible residents, and other cues indicating that the residence was occupied. Surveillability and occupancy were assessed first as they could be determined at a distance (Cromwell et al., 1993). Many of the participants in this study explicitly stated that their greatest fear was that they would come into contact with a resident upon entering a home or that a resident would return while they were in the middle of a burglary. As a result of this fear, the default decision for burglars is that residences are occupied unless there are cues suggesting otherwise; at which point they may conclude that the residence is unoccupied (Cromwell, et al., 1993). In line with this research, interviews conducted with burglary victims as part of the Burglary Reduction Project found that 71% of the burglaries occurred in homes that were unoccupied at the time of the offence. Less than 4% of the burglaries occurred when the offender was fully aware that the residence was occupied (Tilley et al., 1991).

The importance of occupancy as an indicator of the level of burglary risk for individual residences has also been assessed through interviews with police officers and residents. Ham-Rowbottom, Gifford, and Shaw (1999) found that, when other cues were controlled for, police officers rated residences with more traces of occupancy as less vulnerable to burglary and those with fewer traces of occupancy as more vulnerable to burglary. The explanation "it appeared that no one was home" was offered for why a residence was likely to be burglarized 29% of the time and "it appeared to be occupied" was offered 39% of the time as an explanation for why a home was not likely to be burglarized (Ham-Rowbottom et al., 1999). Similarly, residents have been found to assess greater vulnerability to burglary in houses with fewer traces of occupancy (Shaw & Gifford, 1994). In a study conducted by Wright, Logie, and Decker (1995) both active burglars and non-burglar controls indicated that residences with cues suggesting occupancy were less attractive targets while residences with cues suggesting that the residence was unoccupied were attractive targets.

It appears that there are definite differences between residences that have been previously burglarized and those that have not in terms of occupancy. For example, in a study conducted in Salt Lake City, Brown (1985) found that although most houses may show very few definitive signs of absence, burglarized residences had fewer traces of occupancy than non-burglarized residences. Additionally, non-burglarized homes were more likely to have attached garages which reduced the usefulness of cars as indicators of occupancy. The higher number of traces of presence and attached garages for non-burglarized homes indicated greater use of the home by residents (Brown, 1985). Although traces of occupancy are dynamic (e.g., whether a car is present), previously burglarized houses have been found to appear less occupied and have fewer traces of occupancy even when observations take place long after the burglary has occurred (Brown & Altman, 1983).

Clearly, residences that are more frequently left unoccupied are more vulnerable to being burglarized (Hough, 1987). According to Hough, the proportion of time when a residence is unoccupied increases the probability of burglary victimization. This proportion of time when a residence is unoccupied can also be linked to the resident's lifestyles. Accordingly, an active lifestyle appears to increase victimization risk by increasing the attractiveness of residences while guardianship is low (Hough, 1987). In general, victimization is highest for young, single-resident households and those who are out at night or leave their homes empty on a frequent basis (Sampson & Woolredge, 1987). This relationship between the age and lifestyle of residents and the risk of burglary victimization provides additional support for the importance of occupancy (Cohen & Cantor, 1981).

### 1.2.3 *Defensible Space Theory*

Proposed in 1972 by architect Oscar Newman, Defensible Space Theory suggests that characteristics of the environment can inhibit crime by creating the appearance and feeling of a space that is defended by its occupants. Such a physical layout should clearly indicate that the area belongs to a certain group of people and is controlled by those people. Newman argued that criminals should perceive such "occupancy" characteristics, recognize that the space is controlled and defended by its residents and ultimately be deterred from committing crimes in that area (Newman, 1972). According to the theory, design features that act as territorial displays or provide natural surveillance opportunities suggest that residents are concerned about and prepared to defend the area (Shaw & Gifford, 1994).

Newman (1972) was predominantly concerned with architectural aspects of the residential environment which would imply that the inhabitants were in control of the area and were concerned about the territory. These ideas can, however, be carried over into other modifications of the physical environment. For instance, it has been suggested that traces of occupancy should be added to Newman's defensible space theory as it is hypothesized that fewer signs of occupancy lead to increased vulnerability to burglary (Brown, 1985; Brown & Altman, 1981, 1983). Modifications that create the appearance of occupancy should offer households a degree of protection from criminal activity such as burglary. These views have been reflected in certain crime prevention programs that have emphasized the importance of disguising extended absences from home by having friends, family or neighbours collect mail and newspapers, mow the lawn or shovel snow, and so on (Brown, 1985; Brown & Bentley, 1993).

Overall, burglars appear to be easily deterred from a potential target when it appears occupied. The extension of defensible space theory to include environmental modifications that suggest occupancy may therefore be important for the prevention of residential burglaries (Cromwell, et al., 1993). The process by which burglars determine occupancy must first be determined, however, if such modifications are to be optimally effective.

1.2.4 *Burglars' Decision Making Processes*

An understanding of the process by which residential burglars reach decisions of the occupancy and vulnerability of targets will be of significant practical importance as it may allow for new measures in deterring residential burglary. While a multitude of physical cues relating to the vulnerability and occupancy of a residence are present it is quite unlikely that all of these cues are considered. Rather, it is likely that burglars attempt to find satisfactory targets by using a minimal number of cues as opposed to optimal targets by considering all possible cues (Cromwell et al., 1993). Within this view, burglars are not believed to make exhaustive and complex calculations. Rather they are viewed as making simple examinations of the opportunities surrounding them and making guesses which may not be close to optimal (Carroll, 1978). This may be due to the fact that the majority of burglars are either drug addicts or regular users of drugs which may affect the number of environmental cues used in selecting targets (Cromwell, Olson & Avary, 1991). Additionally, burglars are believed to be more opportunistic than calculating and may simply observe a residence that is obviously unoccupied and therefore burglarize it (Cromwell et al., 1993).

In contrast to these views of residential burglars' decision making as a simple process, other researchers in the criminal psychology area believe that burglars, and criminals in general, use more complex decision making models when selecting targets. For example, Brantingham and Brantingham (1981) have proposed that criminals learn the cues, combinations of cues and sequences of cues that must be considered in order to discriminate between good and bad targets and state that in the case of a highly motivated individual the search for these cues may include many stages and much careful searching.

Such a model suggests that criminals use large amounts of time and cognitive energy when selecting targets. Other researchers also feel that rational choice models are essential for understanding criminal decision making. More recently, Tibbetts and Gibson (2002) suggest that researchers should investigate rational choice in criminal decision making with consideration to time-stable individual differences. They reason that individual differences should be included as they may have differential effects on the criminals' abilities to assess and weight the costs and benefits of engaging in criminal activity. By integrating these two types of predictors of criminal activity, Tibbetts and Gibson (2002) propose that we will be better able to predict criminal decision making and therefore prevent criminal activities. In light of the different approaches to understanding criminal decision making, empirical research is needed before conclusive statements can be made about which of these views of criminals', and more specifically burglars', decision making processes is most accurate.

*1.3 The Current Study*

The current study aimed to model how residential burglars make occupancy decisions. Specifically, this research examined which models of decision making best represent burglars' occupancy decisions, the cues that burglars use when making occupancy decisions and their level of accuracy when making such decisions. Three decision making models varying in complexity (i.e., the matching heuristic, Dawe's rule and Franklin's rule) were used to predict participants decisions based on the physical characteristics of the residences in the photographs. These three models were chosen as they represent multiple points on a complexity continuum of decision making models. Based on the bounded rationality theory and literature, it was expected that the simpler matching heuristic would best predict the decisions made by residential burglars' regarding the occupancy of homes. Results of this research will lead to a greater understanding of how humans make decisions in real world environments as well as inform crime prevention programs aimed at reducing the incidence rate of residential burglary. Specifically, this research identified the physical characteristics that are considered by burglars in their decision making as well as decision making strategies used when burglars attempt to determine the occupancy of a potential target residence.

## 2.0 Method

### 2.1 *Participants*

Participants were 40 men who had been convicted of at least one burglary and who were currently serving a sentence at Her Majesty's Penitentiary in St. John's, Newfoundland. The mean age of participants was 27.9 (*SD* = 8.4). Based on self-report measures, the mean age at the time of first offence was 16.2 (*SD* = 5.5), the mean number of convictions for burglary was 7.3 (*SD* = 9.7), the mean number of convictions for any offence was 23.6 (*SD* = 20.0), and the mean number of burglaries without arrest or conviction was 15.0 (*SD* = 30.1).

### 2.2 *Materials*

*Homeowner information package.* Homeowner information packages used in the current study included (a) a Letter of Information that outlined the research project, (b) an Informed Consent Form, (c) a Homeowner's Information Form, and (d) a postage paid self-addressed envelope (see Appendix A for a copy of the Homeowner Information Package).

*Experimental stimuli.* Photographs of 71 residences taken during the summer of 2006 were used. All photographs were altered using Microsoft Paint to eliminate all identifying characteristics such as street numbers, street names, family name signs, and car license plates. The time of day at which the photographs were taken was located in the lower right hand corner of the photograph.

*Participant recruitment form.* Inmates at Her Majesty's Penitentiary were provided with a Letter of Interest regarding the study and were asked to return the signed form if they were interested in participating in the study (see Appendix B). This letter outlined the purpose of the current study, participants' rights, and the tasks required to complete the study.

*Experimental booklet.* The experimental booklet contained, in order, (a) an informed consent form, (b) a demographic information sheet, (c) a sheet containing instructions for participants to view photographs and to indicate, in the spaces provided, whether the residence in the photograph was occupied or unoccupied when the photograph was taken, (d) a sheet containing instructions, and the necessary space, for participants to indicate the reasons why they had made each of their occupancy decisions, and (e) a sheet containing instructions for participants to rate on a 7-point scale (1 = *Not very important* to 7 = *Very Important*) the importance of 16 physical characteristics (previously coded from the 71 photographs; e.g., vehicle present) in making occupancy decisions in general (see Appendix C for a copy of the Experimental Booklet).

2.3 *Procedure*

*Stimuli creation.* In order to select residences to be photographed the City of St. John's, Department of Engineering Street Map (January 05, 2006) was used. The map was divided into ten quadrants (each quadrant = 7.75 $km^2$) and ten streets were then selected randomly from each quadrant. The Access St. John's Property Assessment Search was then used to determine the street numbers that corresponded with residences on each of the 100 streets.[1] Using the list of residential street numbers, one residence on each street was selected randomly.

Researchers delivered a homeowner information package to each of the 100 residences selected. When the homeowner answered the door, the purpose of the research study and the desire to take a photograph of their residence was explained. Homeowners

[1] http://www.stjohns.ca/access/assessment/propertysearch.jsp

were given the option of immediately agreeing to allow a photograph of their home to be taken or to further consider the request and reply at a later date. In cases when the homeowner was not home, the homeowner information package was left at the residence. In addition, to increase the potential number of photographs that could be taken, homeowner information packages were left at the residence adjacent to the residence where the homeowner did not immediately give consent or was unavailable. Due to a low response rate, a second set of residences were selected randomly from the quadrants. The number a houses selected from each quadrant depended on the previous response rate. The goal was to obtain 10, or at least an equal number, of photographs from each quadrant.

Of the 289 residences visited, there was a 25% response rate,[2] with 18% immediately consenting while the remaining 7% mailed in their consent. Of the 73 homeowners who agreed to have photographs taken of their home, 72.6% of consent forms were signed and returned during the researchers visit and 27.4% were returned by mail.

Once consent was obtained for taking a photograph, one of five times (i.e., 9:00 am, 12:00 pm, 3:00 pm, 6:00 pm, and 9:00 pm) for the photograph to be taken were selected randomly. After taking the photograph, the home was checked for occupancy by either knocking on the door or ringing the doorbell.

*Content analysis of photographs.* All photographs were dichotomously coded (1 = yes, 2 = no) based on the following 16 characteristics: (1) vehicle present, (2) security system visible, (3) outside lights on, (4) inside lights on, (5) signs of a dog, (6) children's

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[2] Two homeowners responded after all photographs had been taken, therefore their residences were not photographed. They were, however, included in this calculation.

toys present, (7) windows above ground level open, (8) windows at ground level open, (9) curtains above ground level open, (10) curtains at ground level open, (11) residence was tidy in appearance, (12) mail or newspapers present, (13) landscaping was large enough to conceal a person, (14) deadbolt present, (15) attached garage and (16) whether the photograph was taken at night or at day.

*Inter-rater reliability.* All photographs were coded independently by two researchers in order to assess inter-rater reliability. Cohen's Kappa for each characteristic coded was as follows: (1) vehicle present (.907), (2) security system visible (.769), (3) outside lights on (.654), (4) inside lights on (.718), (5) signs of a dog (1.00), (6) children's toys present (1.00), (7) windows above ground level open (.875), (8) windows at ground level open (.799), (9) curtains above ground level open (.570), (10) curtains at ground level open (.549), (11) residence was tidy in appearance (.651), (12) mail or newspapers present (.793), (13) landscaping was large enough to conceal a person (.502), (14) deadbolt present (.819), (15) attached garage (.967) and (16) whether the photograph was taken at night or day (1.00). The overall Cohen's Kappa was 0.80.

*Participant Recruitment.* Inmates who met the criteria for inclusion in this study were identified by the staff of Her Majesty's Penitentiary. Classifications officers identified inmates who had at least one previous conviction for burglary and provided these inmates with the participant recruitment form explaining the purpose and requirements of the study. Inmates who were interested in participating signed and returned this form to the classifications officers. All forms were then forwarded to the researchers.

*Experimental task.* All participants completed the study individually with a researcher present. The study was completed in an interview room at Her Majesty's Penitentiary on weekdays between the hours of 9-12 and 2-4. Each participant viewed 20 randomly selected 8 x 10 inch photographs. Photographs were shown one at a time and participants were asked to decide if the residence was occupied or unoccupied at the time the photograph was taken. Once participants had made an occupancy decision on each of the photographs, they were asked to view the photographs again and indicate what factors influenced their decision. Participants were informed that they could provide as many or as few characteristics of the residence photograph as they thought were appropriate. Participants were then asked to indicate on a 7-point rating scale (1 = *Not very important* to 7 = *Very important*) how important they felt each of the 16 characteristics, previously coded from the photographs, were in general in determining whether a residence was occupied or unoccupied. On average, participants took 25 minutes to complete the study and were paid $10 for their time.

2.4 *Statistical Analysis*

2.4.1 *Models*

In order to analyze the occupancy decisions made in the first section of this study the data were analyzed using three different models: the matching heuristic, Franklin's rule and Dawe's rule. The first of these models, the matching heuristic, is a simple heuristic whereas the other two models (i.e., Dawe's rule and Franklin's rule) are full-information models. The models were programmed by an independent programmer according to the descriptions provided in Dhami & Ayton (2001).

*Franklin's rule.* This is the most complex model used in the current study. Franklin's model considers all possible cues when predicting a decision. These cues are weighted according to their importance on the decision being made. These cues are then combined in a compensatory fashion (Dhami, 2003). In essence, all cue values are multiplied by their weights and then summed. If the sum is equal to or greater than an average threshold value, then a non-default decision is predicted. Otherwise, a default decision is predicted (Dhami, 2003).

*Dawe's rule.* As a model of fully-rational decision making, Dawe's Rule is simpler than Franklin's rule. It considers all possible cues when predicting a decision. These cues are unit weighted such that the model counts the number of cues that have reached some critical value (Dhami & Ayton 2001). This critical value is defined as the cue value with the greatest proportion of non-default decisions. If the sum of these cues is greater than or equal to the threshold value, the average of the critical values across all cases, Dawe's Rule will predict a non-default decision whereas if the sum of these cues does not meet or exceed the threshold then Dawe's Rule will predict a default decision (Dhami & Ayton, 2001). Using the example of determining the occupancy of a residence, Dawe's Rule would sum all the cues that indicated that the residence was unoccupied. If the sum of these cues reached the threshold then the model would predict that the residence is unoccupied whereas if the sum of these cues did not reach the threshold the model would predict that the residence was occupied.

*The matching heuristic.* The matching heuristic is a flexible, noncompensatory heuristic model of human decision making (Dhami, 2003). It is noncompensatory because it bases its predictions or decisions on only one cue and these decisions are not altered by the values of other cues. This model is considered flexible because it can use different cues when making different decisions. In order to reach a decision the matching heuristic rank orders cues by their utilization validities and then searches through these cues in the order of their validities for any cue that exceeds a critical value. Cue utilization validities are the proportion of cases with the critical value that had a non-default decision and the critical value is the value of a cue that is most often followed by a non-default decision. This indicates that a non-default decision should be made. If a cue that exceeds a critical value is found the search is terminated and the non-default decision is made. Otherwise the search continues until all the cues have been searched and the default decision is made (Dhami, 2003). See Figure 1 for a diagrammatic representation of the matching heuristic's decision making process. Using the example of determining the occupancy of a residence, the matching heuristic would search through cues in the order of the utilization validities until a cue was found that indicated that the residence was unoccupied. At this point it would stop search and predict that the residence is unoccupied. If all cues were searched and a cue indicating that the residence was unoccupied was not found then the matching heuristic would predict that the residence was occupied.

2.4.2 *Decisions*

The performance of the models is measured based on relative and absolute accuracy. Relative accuracy is the percentage of photographs for which the models correctly predict the participant's occupancy decisions. Absolute accuracy is the percentage of photographs for which the models correctly predict the actual occupancy of the residence. In order for this analysis to be completed all physical characteristics that

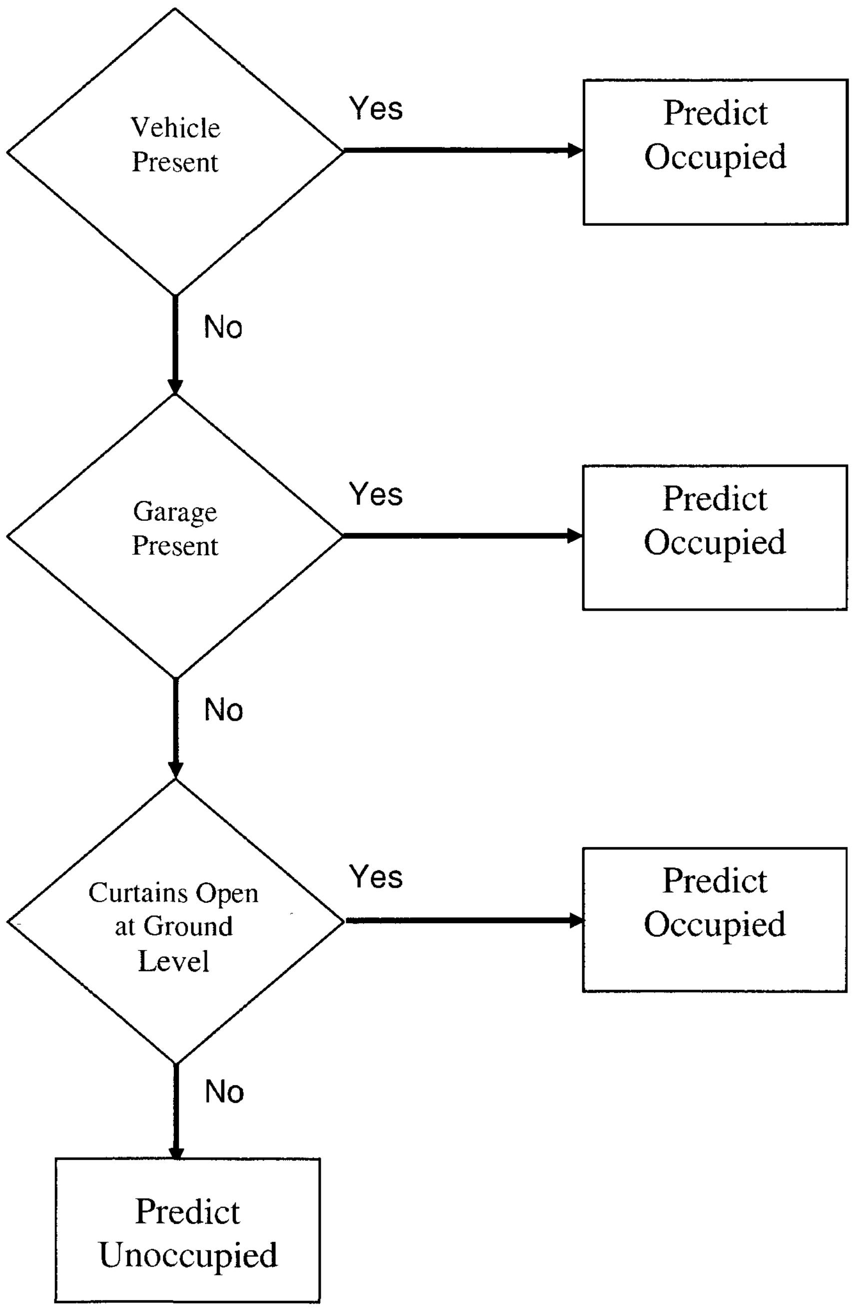


*Figure 1*. Example of the matching heuristic decision making process.

were coded as present in fewer than 20% of the photographs were removed. The following eight physical characteristics remained in the analysis: vehicle present, security system visible, windows above ground level open, curtains above ground level open, curtains at ground level open, landscaping was large enough to conceal a person, deadbolt present, and attached garage. The correlations between these cues are presented in Table 1.

2.4.3 *Reasons*

Participants' reasons for each of their occupancy decisions were broken down into their first, second, third, and fourth reasons. Participants' reasons were independently coded by two researchers in order to assess inter-rater reliability. Cohen's Kappa for each reason given was as follows: (1) first reason (.946), (2) second reason (.893), third reason (.893), and fourth reason (1.00). The frequencies of the reasons indicated by participants for deciding whether each residence was occupied were compiled.

2.4.4 *Ratings*

Participants' ratings of the importance of various physical characteristics of residences in making occupancy decisions in general were analysed as mean importance ratings for each physical characteristic. All 16 physical characteristics originally coded in the photographs were rated by participants.

Table 1

*Correlations Among Physical Characteristics Coded in Photographs*

| | Physical Information | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | | | | | | | |
| 2 | .063 | | | | | | |
| 3 | -.099 | .251* | | | | | |
| 4 | -.180 | .264* | .325** | | | | |
| 5 | .044 | .116 | -.058 | .150 | | | |
| 6 | -.102 | .136 | -.054 | .158 | .168 | | |
| 7 | -.242* | .147 | -.015 | .150 | .302* | .290* | |
| 8 | .008 | .175 | .313** | .150 | -.080 | .136 | .269* |

1 = Vehicle present; 2 = Security system visible; 3 = Windows above ground level open; 4 = Curtains above ground level open; 5 = Curtains at ground level open; 6 = Landscaping was large enough to conceal a person; 7 = Deadbolt present; 8 = Attached garage

3.0 Results

Of the 800 decisions made by the burglars, 477 (59.6%) were "occupied" decisions and 323 (40.4%) were "unoccupied" decisions. In actuality, of those 800 decisions participants were asked to make, 503 (62.9%) of the residences were occupied and 297 (37.1%) were unoccupied.

3.1 *Relative predictions*

*Cue data.* The number of cues used by the matching heuristic to predict participants' occupancy decisions ranged from 1 to 2 ($M = 1.08$, $SD = .27$, *95% CI* = .99 to 1.16). The majority of participants (93%) used one cue according to the matching heuristic. The percentage of participants for whom each cue was used by the matching heuristic along with the mean cue utilization validities are shown in Table 2. According to the matching heuristic's modelling of participants' decision, 70% of participants used the presence of a vehicle to make their occupancy decisions. According to the matching heuristic all other pieces of information were used in 7.5% or fewer of the participants' decisions.

*Hit rates.* The hit rate was defined as the proportion of the 20 targets on which the models correctly predicted each participant's occupancy decisions. The mean hit rate, or relative accuracy, was 80% (95% *CI* = 77 to 83) for the matching heuristic, 75% (95% *CI* = 73 to 77) for Franklin's rule, and 73% (95% *CI* = 70 to 75) for Dawe's rule.

Hit rates were analysed in a one-way analysis of variance. This analysis revealed a significant main effect for model, $F(2, 117) = 8.376$, $p < .00$. Each model was then compared to each other model using paired sample t-tests. Every model was found to be

Table 2

*Frequencies and Parameters for Models' Predictions of Participants' Occupancy Decisions*

| Piece of Information | Percentage of Participants (*N* = 40) For Whom Piece of Information was Used by Matching Heuristic | Mean Utilization Validity in Matching Heuristic | Weight Assigned to Pieces of Information in Franklin's Rule |
|---|---|---|---|
| Vehicle present | 70% | .50 | .61 |
| Security system visible | 2.5% | .37 | .48 |
| Windows above ground level open | 7.5% | .42 | .46 |
| Curtains above ground level open | 0% | .41 | .46 |
| Curtains at ground level open | 5% | .49 | .49 |
| Landscaping was large enough to conceal a person | 5% | .43 | .45 |
| Deadbolt present | 7.5% | .48 | .52 |
| Attached garage | 7.5% | .43 | .44 |

significantly different from each other model. The matching heuristic was significantly more accurate at predicting participants' occupancy decisions than Franklin's rule, $t(39) = 3.55$, $p = .001$, $d = .61$, and Dawe's rule, $t(39) = 4.19$, $p = .00$, $d = .67$. Franklin's rule was also significantly more accurate at predicting participants' occupancy decisions than Dawe's rule, $t(39) = -2.72$, $p = .01$, $d = .44$ (see Table 3).

3.2 *Absolute predictions*

*Information data.* The number of cues used by the matching heuristic to predict the actual occupancy state of residences ranged from 1 to 2 ($M = 1.10$, $SD = .30$, 95% $CI = 1.00$ to 1.20). For the majority of participants (90%), the matching heuristic used one piece of information to predict the actual occupancy of the residences in the photographs they were presented. According to the matching heuristic, approximately 43% of participants should have used the presence of a vehicle to best predict whether a residence was occupied. Additionally, approximately 30% and 15% of participants should have used the presence of a deadbolt or the curtains open at ground level pieces of information, respectively.

*Hit rates.* The mean hit rate for the actual occupancy state of the residences (i.e., absolute accuracy) was 74% (95% $CI = 71$ to 76) for Franklin's rule, 73% (95% $CI = 71$ to 75) for the matching heuristic and 73% (95% $CI = 69$ to 76) for Dawe's rule (see Figure 2).

Table 3

*Follow-Up t-tests Comparing Accuracy of Three Models in Predicting Participants' Occupancy Decisions*

| Model | Model | |
|---|---|---|
| | Franklin's Rule | Dawe's Rule |
| Dawe's Rule | $t(39) = -2.72$, $p = .01$, $d = .44$ | |
| Matching Heuristic | $t(39) = 3.55$, $p = .001$, $d = .61$ | $t(39) = 4.19$, $p = .00$, $d = .67$ |

*Note*. Positive *t* values indicate greater accuracy for the column model compared to the row model. Negative *t* values indicate the reverse. Effect size d values were obtained using the appropriate formula for calculating effect sizes for within participant comparisons.

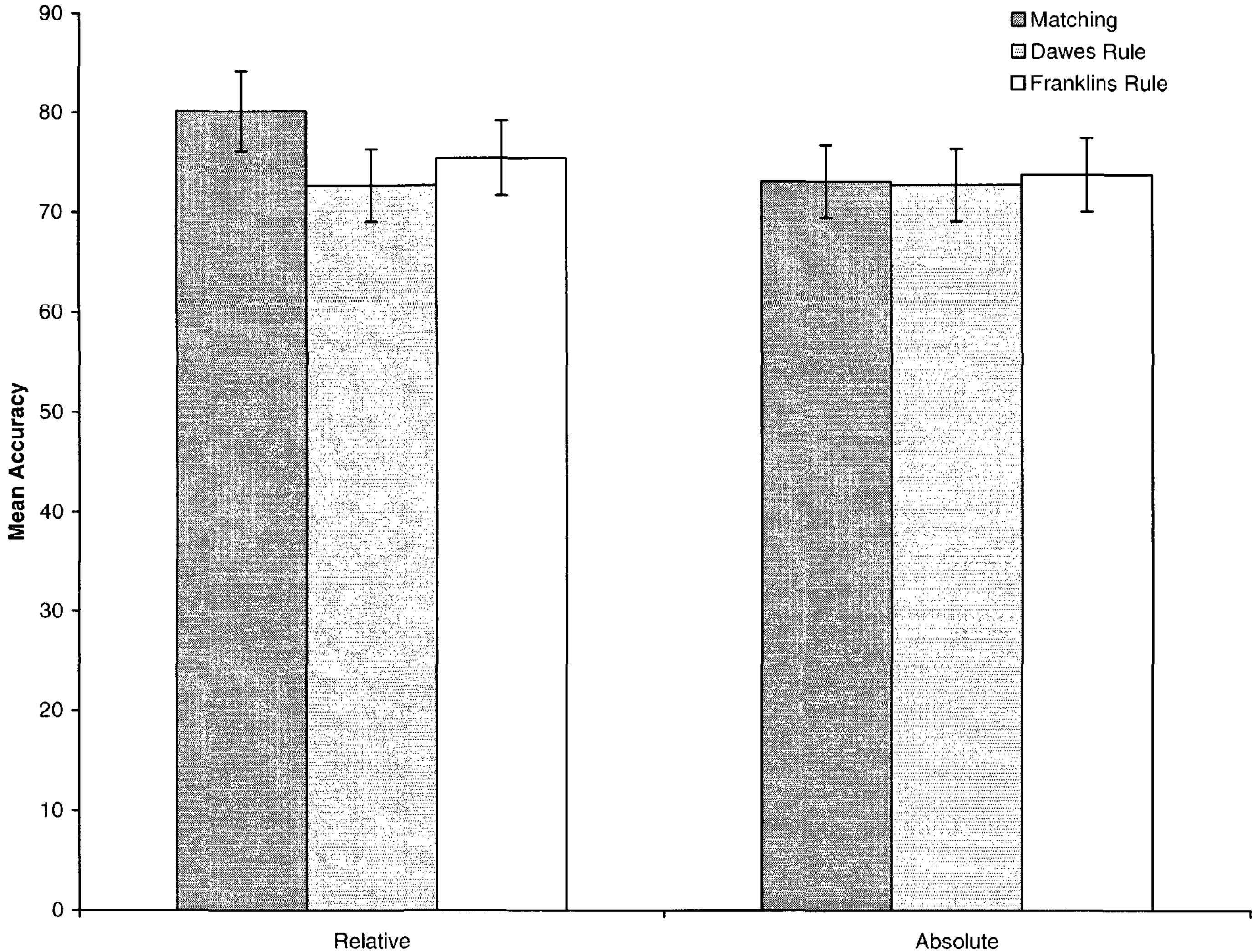


*Figure 2*. Mean accuracy of the matching heuristic, Dawe's rule, and Franklin's rule.

Absolute accuracy was analysed in a one-way analysis of variance. No significant differences were found between any of the models based on absolute accuracy.

3.3 *Decision reasons*

A descriptive analysis of the reasons that participants indicated for making each of their occupancy decisions was conducted. The majority of the time (55%) the first reason given was the presence or absence of a vehicle in the photograph. This is in line with the results of the matching heuristic for the relative predictions indicating that burglars are relatively aware of the cues they are using to make their decisions. The next most common first reason was "It just looks like…" (e.g., "It just looks like there is somebody home.") which was used approximately 10% of the time. According to participants' own reports, the majority (63%) of occupancy decisions were made using only one physical characteristic present in the photograph. However, when more than one reason for a decision was provided the most common second reason was the presence or absence of a vehicle. This was reported approximately 11% of the time. The use of three and four physical characteristics was reported less than 7% and 1% of the time, respectively.

3.4 *Information ratings*

Mean participant ratings of the importance of various physical characteristics of residences in making occupancy decisions in general were compiled. The most highly rated physical characteristic was the presence or absence of a security system ($M$ = 5.68) followed by the presence or absence of mail and newspapers ($M$ = 5.28), the time of day ($M$ = 5.00) and the presence or absence of a vehicle ($M$ = 4.98). The physical characteristics receiving the lowest ratings of importance from participants were whether there are outside lights on (*M* = 3.30), whether there is a deadbolt present (*M* = 3.45), and whether there is an attached garage present (*M* = 3.50; see Table 4 for all mean ratings).

Table 4

*Mean Ratings of Importance of Physical Characteristics of Residences in Making Occupancy Decisions in General*

| Piece of Information | Mean Rating | Standard Deviation |
|---|---|---|
| Security system visible | 5.68 | 1.91 |
| Mail or newspapers present | 5.28 | 1.84 |
| Time of day | 5.00 | 1.84 |
| Vehicle present | 4.98 | 1.69 |
| Inside lights on | 4.78 | 1.56 |
| Windows at ground level open | 4.75 | 1.79 |
| Children's toys present | 4.63 | 2.15 |
| Landscaping was large enough to hide a person | 4.33 | 1.46 |
| Signs of a dog | 4.20 | 2.09 |
| Curtains at ground level open | 3.98 | 1.66 |
| Windows above ground level open | 3.93 | 1.64 |
| Residence was tidy in appearance | 3.68 | 2.01 |
| Curtains above ground level open | 3.63 | 1.44 |
| Attached garage present | 3.50 | 1.84 |
| Deadbolt present | 3.45 | 2.04 |
| Outside lights on | 3.30 | 1.68 |

## 4.0 Discussion

In line with recent studies that have explored how people make decisions in everyday situations, the current study modeled how residential burglars decide whether potential targets are occupied or unoccupied using three models of decision making (the matching heuristic, Dawe's rule and Franklin's rule) as representatives of the range of complexity seen in decision making models. It was expected, based on the bounded rationality literature and ethnographic research on burglars, that the simple matching heuristic would best represent residential burglars' occupancy decision making.

### 4.1 *Comparability with Previous Research*

Previous studies in the area of bounded rationality have been primarily of two types. They have either tested heuristic models in situations where accuracy was determinable but the decisions being made were unrelated to the requirements of real life or they have examined heuristic models in real life decision making situations where the accuracy of the decisions could not be established. The current study overcomes the limitations of each of these two study types by modeling real life decisions where the accuracy of these decisions can be determined. Therefore the results of the current study extend the bounded rationality research area.

In terms of relative predictions, the matching heuristic was more frugal than the other two models. It used on average 1.08 cues whereas both Dawe's rule and Franklin's rule used all available cues. Additionally, the matching heuristic was also the most accurate model, predicting 80% of participants' decisions accurately. When modelling the actual occupancy of residences (i.e., absolute predictions) the matching heuristic used fewer cues. While Franklin's rule was slightly more accurate than both the matching heuristic and Dawe's rule, there were no significant differences between the models based on the accuracy of their absolute predictions. Using the matching heuristic as an example of fast and frugal heuristics, it appears that simple models of decision making are able to predict residential burglars' occupancy decisions and actual occupancy states equally as well as or better than complex models while using only a small subset of cues.

These results are in line with those of Dhami (2003) and Czerlinski et al. (1999), among other researchers. Similar to the current study, Dhami found that the matching heuristic was better able to predict judges' bail decisions. Czerlinski and colleagues found that the fast and frugal Take the Best model was able to make correct decisions in a variety of areas such as psychology, economics, and biology. Overall it appears that fast and frugal heuristics are able to accurately predict peoples' decisions in real life situations as well as lead to correct decisions in situations where there are right and wrong choices. Therefore, people should be able to make use of heuristics to make accurate decisions in everyday situations.

These results further inform theories of criminal decision making. While the majority of previous theories suggested that a complex process is involved in criminal decision making the current results support the work of researchers such as Cromwell and colleagues (1993) who believe that criminals make simple examinations of the opportunities surrounding them and make guesses about which targets are best. Future research in this area should aim to determine more specifically the simple heuristics that burglars use in order to determine if residences are occupied. In the current study, even though the matching heuristic was more accurate in predicting burglars' decisions this does not mean that burglars are actually using the matching heuristic to predict occupancy. Rather, the results simply show that a simple model such as the matching heuristic can accurately predict burglars' occupancy decisions. Additionally, this research should attempt to create more realistic decision making situations where burglars can provide occupancy decisions and the accuracy of these decisions can still be determined.

The present results have implications for bounded rationality research as well as for our understanding of residential burglary. By identifying the physical cues that residential burglars use to determine whether residences are occupied or unoccupied it may be possible to determine how to reduce the probability of a residence being burglarized by modifying these environmental cues. In the current study it was found that the majority of residential burglars used the presence or absence of a car in the photograph as their primary indicator as to whether the home was occupied or unoccupied. After this the second most often used cue was just the offenders' intuitions about what the residence looked like. According to participants' own reports, 63% of decisions in the current study were made by using only one cue. When participants were asked to rate the importance of a variety of cues the three cues with the highest ratings were the presence or absence of a security system, the presence or absence of mail or newspapers and the presence or absence of a vehicle. These results match those of Cromwell et al. (1993) where the presence of cars near a residence as well as visible residents and other cues were found to be used by burglars' when determining whether a residence was a suitable target.

The current research has implications for the prevention of residential burglary. Defensible Space Theory states that characteristics of the environment associated with a residence can inhibit crime by creating the appearance and feeling of a space that is defended by its occupants, for example by being occupied (Newman, 1972). Accordingly, manipulation of the cues found to be important for burglars' occupancy decisions in the current study could reduce the likelihood of a residence being burglarized. Therefore, based on the results of the current study, keeping a vehicle in view when possible, installing a security system or simply displaying security system signs, and picking up all mail and newspapers in a timely fashion may inhibit a residence from being burglarized.

### 4.2 *Limitations*

While the current results are consistent with those of previous research they should be interpreted with consideration to the limitations of the research. These include the participant sample, the type of experimental stimuli used, the lack of a training set, and potential priming of participants.

Firstly, the sample was made up of incarcerated offenders who had at least one previous conviction for burglary. The use of incarcerated offenders may limit the generalizability of the results as they may not be as proficient as non-incarcerated offenders when making occupancy decisions. Most burglaries are successful, however, as few lead to arrests. Incarcerated burglars are likely to have been arrested for only a few of their crimes. Additionally, even when residential burglars are caught it is often the result of factors other than poor judgment in target selection. The majority of burglars report being caught some time after their burglaries took place because of information provided by the victim or witnesses or through police questioning of known offenders (Bennett & Wright, 1984). Consequently, just because a burglar is incarcerated does not necessarily mean that they are poor at selecting targets (Brown & Bentley, 1993).

Secondly, the use of photographs as experimental stimuli may have limited burglars' occupancy decisions in ways that are not present when actual target selection decisions are being made. There were no auditory stimuli available as there would be when looking at a house in person. Nor were neighbours' homes included in the photographs. Therefore, there were many cues that participants could not avail of which they may have used in an actual burglary situation. Also, viewing the photographs did not allow the burglars to get closer to the residences or take actions such as knocking on the door to determine if the residences were occupied. Therefore, while the accuracy of participants' decisions using the photographs presented was only 63% overall, these residential burglars may actually be quite adept at making occupancy decisions. They may simply not have been presented with all of the cues they would normally use when engaged in a target selection situation. The use of photographs as experimental stimuli is not completely unwarranted, however, as color photographs can be quite accurate simulations of actual environments (Wood, 1972). The use of photographs also eliminates a potential caveat. Having participants make occupancy decisions using photographed residences avoided issues of retrospection as would have occurred if participants had been asked to discuss the cues they had previously used in making occupancy decisions (see Shaw & Gifford, 1994).

Thirdly, the lack of a training set followed by a cross-validation set reduces our ability to determine how accurate the models would be when predicting novel decisions after a training set. Using both a training set and a cross-validation set enables decision making researchers to determine whether models exhibit overfitting by over-generalizing the training set to the cross-validation set. Future research in this area should consider including both modelling stages in order to determine whether the models tested overfit residential burglars' decisions from the training set to the cross-validation set. The matching heuristic has been found to overfit less than Dawe's rule and Franklin's rule on other decisions, however, it remains to be determined if those findings extend to offenders' occupancy decision making (Dhami & Ayton, 2001)

Finally, participants' responses may have been influenced by the information provided in the participant recruitment form. Participants were informed that the purpose of the study was "to determine what visual cues individuals with at least one previous conviction for burglary consider when trying to determine whether a residence is currently occupied" and that participants would be asked "what information from the picture[s] they considered" (see Appendix B). While this information does not tell participants what responses were expected it does prime them to consider, in general, what information they believe is important when attempting to determine whether a residence is occupied or unoccupied. Future research in this area should attempt to eliminate these potential priming effects by providing less specific information to participants.

4.3 *Conclusions*

The current research adds to the cumulating findings suggesting that fast and frugal heuristics are accurate representations of decision making in time and information limited environments. Future research in this specific area should attempt to model residential burglars' decision making on other target selection decisions. In the more general bounded rationality area, future research should attempt to model decision making in other areas where real life, consequential decisions are required while simultaneously determining the accuracy of these decisions.

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6.0 Appendix A

Dear Sir or Madame,

You are being contacted as part of a study being conducted in the Department of Psychology at Memorial University of Newfoundland. The purpose of this study is to determine what visual cues house burglars use when trying to determine whether a potential target residence is currently occupied. This study involves approximately 100 residences from the greater St. John's area being photographed. Your residence has been randomly selected to be included in this study.

Briefly, this study involves a researcher knocking at the residence at the time the photograph is taken to determine whether the residence is occupied at that time. Any information identifying the location or ownership of a residence (street names, house numbers, vehicle licence plates, family name signs, etc.) will be removed from all photographs. Participants in this study will be offenders currently serving a sentence at Her Majesty's Penitentiary in St. John's, Newfoundland who have at least one prior conviction of burglary. Once a participant has viewed a photograph they will be asked whether they think the residence was occupied at the time the photograph was taken. They will then be asked what visual cues in the photograph led them to make this decision and to rank these cues from most to least important for their decision.

Previous research has shown that the presence of occupants at a residence is a major deterrent for burglars. Approximately 90% of burglars interviewed in a previous study stated that they would be deterred from burglarizing a house simply because it appeared occupied. Because occupancy seems to be a major reason why a given residence would not be burglarized it is important to determine how burglars decide whether a house is occupied or not. Based on this information homeowners may be able to alter certain aspects of their home environment in order to reduce their chances of being burglarized.

We would appreciate your consent to allow us to take a photograph of your residence between the dates of July 17, 2006 and September 1, 2006. Please find enclosed in this package a consent form outlining the important aspects of this study. Also included is a homeowner's information form for contact information and descriptive purposes. Both forms may be returned using the postage paid envelope provided in this package. If you consent to participate in this study and wish to view the photograph of your residence after it has been altered, please indicate "Yes" on the homeowners information form included in this package.

For questions about this study please contact Brent Snook (Department of Psychology, Memorial University of Newfoundland, 709-737-3101). We can also be contacted by e-mail at Memorial_University_Burglary_Study @hotmail.com or by fax at 737-2430. The proposal for this research has been approved by the Interdisciplinary Committee on Ethics in Human Research at Memorial University of Newfoundland (ICEHR) and has been endorsed by Corrections and Community Services, Department of Justice. Should you have any ethical concerns about the research you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 737-8368.

Thank you for your time and consideration.

**HOMEOWNERS**
**INFORMED CONSENT FORM**

The purpose of an informed consent form is to ensure that you, as the participant, understand the purpose of the study as well as the nature of your involvement.

**Research Title:** Exploring the use of visual cues in burglars' determinations of occupancy in potential targets.

**Research personnel:** For questions about this study please contact Brent Snook (Department of Psychology, Memorial University of Newfoundland, 709-737-3101). The proposal for this research has been approved by the Interdisciplinary Committee on Ethics in Human Research at Memorial University of Newfoundland (ICEHR) and Corrections and Community Services, Department of Justice. Should you have any ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 737-8368.

**Purpose:** The purpose of this study is to determine the type of visual cues used by burglars in order to make determinations of occupancy in potential targets.

**Task requirements:** All that is required is your consent for a photograph to be taken of your residence.

**Duration:** This study is not expected to require any time on your part.

**Potential risks:** We do not foresee any potential risks based on your helping with this research study.

**Benefits:** Your help with this study will be contributing toward the current body of literature on the use of visual cues in determining the occupancy of homes prior to a burglary.

**Anonymity and confidentiality:** The data collected in this study are coded with a number that is not associated with your name; therefore, all data are anonymous. The data will be used only by researchers associated with this project for the purpose of research publications, conference presentations, or teaching material. All informed consent forms will be stored confidentially in a locked filing cabinet. Any information identifying the location or ownership of a residence (street names, house numbers, vehicle licence plates, family name signs, etc.) will be removed from all photographs. If you wish to view the photograph of your residence after is has been altered to remove any identifying features please indicate "Yes" on the homeowners information form included in this package. If after viewing this photograph you feel uncomfortable with your residence being included in this study you may withdraw your consent at any time.

**Right to withdraw:** Your help with this study is entirely voluntary. At any point during the study you have the right to withdraw your consent for the use of the photograph of your residence.

**Signatures:** I have read the above description and I understand that the data in this study will be used in research publications or for teaching purposes. My signature indicates that I agree to participate in this study.

Participant's name: ________________________ Participant's signature: ________________________

Date: ________________________

**Thank you for your cooperation in participating in this study!**

**HOMEOWNER'S INFORMATION**

Name: ____________________________________

Home Address: ____________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

Telephone Number: __________________

Email Address: ____________________________________

Would you like to view the altered photograph of your residence before it is used in this study? YES / NO

Would you like to receive the results of this study by email? YES / NO

This section to be completed by researcher.

Experimental house number: ___________

Date of photograph: ___________

Time of photograph: ___________

Occupied / Unoccupied at time of photograph.

7.0 Appendix B

Dear Sir,

You are being contacted to participate in a two part study being conducted in the Department of Psychology at Memorial University of Newfoundland. The purpose of this study is to determine what visual cues individuals with at least one previous conviction for burglary consider when trying to determine whether a residence is currently occupied.

In part one of this study, participants will be asked to view 20 photographs of different houses. After viewing each photograph participants will be asked whether they think the house was occupied at the time that the photograph was taken. Once this decision is made participants will be asked what information from the picture they considered and to rank order this information from most to least important. This part of the study should take no longer than 60 minutes to complete.

In part two of this study, participants will be asked to complete a computer exercise. Information on several different residences will be available on the computer screen. Participants must select one piece of information to view at a time. There will be a limited amount of time to view the information, at the end of which participants are required to choose which residence is most vulnerable to burglary. This part of the study should take no longer than 30 minutes to complete.

The data collected in this study are coded with a number that is not associated with participant names and therefore all data are anonymous. The data will be used only by researchers associated with this project for the purpose of research publications, conference presentations, or teaching material. Consent forms will be kept separate from participant data. Also, all consent forms will be stored confidentially in a locked filing cabinet.

Participation in this study is entirely voluntary and is not a requirement of any sentence at Her Majesty's Penitentiary. At any point during the study you have the right to not answer any question or to withdraw with no penalty.

You may choose to participate in one or both parts of this study. Each part of the study will be conducted on different days. All participants will be reimbursed $10 for each part of the study in which they participate. During the study the researcher will only be able to discuss and explain the requirements of the study. Due to the requirements of the research no other discussion may take place.

If you are interested in participating in this study please fill in the information at the bottom of this form.

Thank you for your time and consideration.

Name: ______________________________

Release Date: ________________________

# 8.0 Appendix C

## DEMOGRAPHICS

All data derived from these answers will be used for descriptive purposes only. This data is not associated with participants in any way.

Age: __________

Age at First Offence: __________

Number of Previous Convictions for Burglary: __________

Number of Previous Convictions for any Offence: __________

Total Number of Residences Previously Burglarized Without Arrest/Conviction: __________

**INSTRUCTIONS**

Please study the photographs of residences as they are presented to you. Based on the physical information in the photographs please circle either occupied or unoccupied based on whether you think the residence was occupied or unoccupied at the time the photograph was taken.

1. House #: ____________ Occupied / Unoccupied

2. House #: ____________ Occupied / Unoccupied

3. House #: ____________ Occupied / Unoccupied

4. House #: ____________ Occupied / Unoccupied

5. House #: ____________ Occupied / Unoccupied

6. House #: ____________ Occupied / Unoccupied

7. House #: ____________ Occupied / Unoccupied

8. House #: ____________ Occupied / Unoccupied

9. House #: ____________ Occupied / Unoccupied

10. House #: ____________ Occupied / Unoccupied

11. House #: ____________ Occupied / Unoccupied

12. House #: ____________ Occupied / Unoccupied

13. House #: ____________ Occupied / Unoccupied

14. House #: ____________ Occupied / Unoccupied

15. House #: ____________ Occupied / Unoccupied

16. House #: ____________ Occupied / Unoccupied

17. House #: ____________ Occupied / Unoccupied

18. House #: ____________ Occupied / Unoccupied

19. House #: ____________ Occupied / Unoccupied

20. House #: ____________ Occupied / Unoccupied

**INSTRUCTIONS**

You have previously view 20 photographs of residences and stated whether you believe the residence was occupied or unoccupied at the time the photograph was taken. At this point, please list what physical cues in the photograph led you to your decision on occupancy.

1. House #: ____________

Physical Cues:

2. House #: ____________

Physical Cues:

3. House #: ____________

Physical Cues:

4. House #: ___________

Physical Cues:

5. House #: ___________

Physical Cues:

6. House #: ___________

Physical Cues:

7. House #: ___________

Physical Cues:

8. House #: ___________

Physical Cues:

9. House #: ___________

Physical Cues:

10. House #: ___________

Physical Cues:

11. House #: ___________

Physical Cues:

12. House #: ___________

Physical Cues:

13. House #: ___________

Physical Cues:

14. House #: ___________

Physical Cues:

15. House #: ___________

Physical Cues:

16. House #: ___________

Physical Cues:

17. House #: ___________

Physical Cues:

18. House #: ___________

Physical Cues:

19. House #: ___________

Physical Cues:

20. House #: ____________

Physical Cues:

<u>**INSTRUCTIONS**</u>

Please rate each piece of information on a scale from 1 to 7 with 1 indicating the information would not be very useful in making decisions regarding occupancy and 7 indicating the information would be very useful in making decisions of occupancy in general.

**Time of day**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Vehicle present**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Security system present**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Outside lights on**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Inside lights on**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Signs of a dog**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Children's toys present**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Windows above ground level open**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Windows at ground level open**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Curtains above ground level open**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Curtains at ground level open**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Tidy appearance of property**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Mail or newspapers present**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Landscaping large enough to hide a person present**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Deadbolt present**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |

**Attached garage present**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not Very Important | | | | | | Very Important |