



IDENTIFICATION OF CLANDESTINE GRAVE SITES BY UNDERSTANDING  
LOCATION CHOICES FROM AN ENVIRONMENTAL AND PSYCHOLOGICAL  
PERSPECTIVE

By

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in

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## DECLARATION

I declare that this thesis does not contain any material submitted previously for the award of any other degree or diploma at any university or other tertiary institution. Furthermore, to the best of my knowledge, it does not contain any material previously published or written by another individual, except where due references have been made in the text. Finally, I declare that all reported experimentations performed in this research were carried out by myself, except that any contribution by others, with whom I have worked is explicitly acknowledged.

Signed: \_\_\_\_\_ 08/12/2021

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In the gospel according to Gay Icon Elizabeth Eden Harris (aka CupcakKe), the book of Audacious, hymn LGBT, she pontificates that:

*“Don't judge a lesbian, 'cause she don't want you back, man (woo)*

*Judge one of the gays, they drag you from Z to A (they will)*

*And shout out to the bi's, you ain't gotta pick a side (nope)*

*And if you in the closet, shorty, you ain't gotta hide (come out)”*

The scripture lets it be known that everyone in the Alphabet Mafia® are powerful and not to messed with. My completing this degree has fulfilled this promise that we are a strong community that knows no bounds. As the chairwoman of the LGBTQIA community, her guidance has led me through this Master's degree and unto her I give my lifelong service.

Thanks also goes to another Gay Icon Montero Lamar Hill (aka Lil Nas X) whose entire discography was played on repeat throughout my study sessions and research writing. Lil Nas X's powerful tracks provided the absolute motivation to everything done. My devotion goes to him (praise be).

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**PART ONE**  
**LITERATURE REVIEW**

IDENTIFICATION OF CLANDESTINE GRAVE SITES BY UNDERSTANDING  
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**MASTERS IN FORENSIC SCIENCE LITERATURE REVIEW**

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## **1.0 ABSTRACT**

What factors influence an offender's decision-making process in choosing a particular clandestine grave site? This study attempts to answer this question and in doing so proposes that it is best answered using a multifaceted approach. This approach is required to appreciate how Winthroping is a relevant method to employ to understand these decision-making factors. An offender's decision-making process is affected by theoretical underpinnings in forensic psychology and environmental criminology. Forensic psychology informs us that the environment plays a significant role in influencing decisions made by an offender, who scours it consciously and subconsciously for relevant information about how best to commit their crime. Environmental criminology states that these decisions aggregate to form larger trends about how crime is committed across geographical areas and how best we can use these to apprehend offenders. Furthermore, knowledge gained by applying statistical methods such as Matrix Forecasting, and Behavioural Sequence Analysis can form the foundation of testing whether Winthroping can be used as a clandestine grave search tool. Finally, the forensic components and unique characteristics of clandestine graves will be discussed in relation to Winthroping. The potential impact of this research may reduce the reliance on offenders telling us where to find their victims as well as provide a new method for investigators to use in their current cases.

**KEY WORDS:** Forensic Psychology, Environmental Criminology, Satisficing, Affordance, Rational Choice Theory, Routine Activity Theory, Matrix Forecasting, Behavioural Sequence Analysis, Winthroping

## 2.0 INTRODUCTION

Winthroping is a novel technique, and few research articles have looked at applying it in a forensic setting. Therefore, a theoretical understanding of Winthroping needs to be developed to shed light on how it works. Several theories are important in determining how Winthroping can work, those being in Forensic Psychology and Environmental Criminology. These theories explain the decision-making processes offenders go through and how this influences their behaviours when committing their crimes. Decision-making and offender behaviour determine the burial sites that are chosen. This review introduces the reader to the concepts of Evolutionary Psychology (EP), affordance, satisficing that are apart of Forensic Psychology. These theories dictate how the environment plays a role in shaping the behaviour of the offender. Furthermore, we also consider the impact that Rational Choice Theory (RCT) and Routine Activity Theory (RAT) has in determining crime trends and patterns in geographical areas. Also discussed is geographical profiling, the technique based on RCT and RAT that is used in apprehending offenders based on geographical information. The process that guides the burial of a body can be thought of in two distinct parts where psychology and criminology theories determine how the offender gets to the point of committing the offence and disposing of the body and forensic understandings which guide what happens once the body is disposed of and how we use this to apprehend the offender. From this, we provide a detailed overview of the forensic archaeological and crime scene perspectives to explain what occurs after the death event. Finally, we introduce the methodology required to test Winthroping to determine what we can learn about the decisions offenders make in selecting clandestine grave sites.

## 3.0 DISCUSSION

### 3.1 Forensic Psychology

Evolutionary Psychology, affordance, and satisficing are concepts that are useful in determining the role that the environment has on influencing behaviours of individuals and their relationship to why offenders offend. The relationship between the environment and the individual is necessary because it guides how Winthroping can be used to locate clandestine graves.

#### *3.1.1 Evolutionary Psychology*

Evolutionary psychology in essence merges our understanding of evolution in nature, and topics of natural selection, and utilise this in explaining psychological traits that may be present (1). These psychological traits would have come about because of the environmental pressures on our ancestors and therefore serve as an adaptation to this environment to help them survive it (1). Just as our biology has been shaped by evolution throughout time, these pressures would have had an influence on the cognitive ability's humans have gained from our ancestors (1). Theorists posit that to understand the complex functionalities of the brain and human cognition, we also need to gain a deeper appreciation of the environment and adaptations that have shaped it. Some of the core tenets that evolutionary psychology is based upon inform us that the brain's mechanisms have been shaped by natural selection and that these mechanisms have evolved as a response to evolutionary pressures which have resulted in the presence of some of cognitive abilities to solve complex problems (1).

Moreover, human psychology arises due to these mechanisms and combine to produce behaviours that we see today. The presence of altruism and altruistic behaviour within humans is a key example of a complex trait that can be explained by evolutionary psychology (1). Altruism is a pro-social trait that is not often found in most other species and could be a direct result of the social nature of humans, where its presence can be explained because of the benefits it affords. These benefits include increasing the social standing of the individual, which increases the resources that are available to them, as well as benefitting the family/friend group of which they are a part of. Studies have shown that women find the altruistic trait in men more attractive, because these men would be more likely to share resources with her and her offspring (1). EP has been used in a variety of research to assist our understanding of issues that arise in classical evolution, as well as psychology proper. The area has been used to explain the concept of consciousness, which briefly can be summarised as existing because it helped our ancestors consider their mass when climbing and swinging from trees (1). Moreover, as we have developed over time consciousness serves as a unique tool to increase our capacity in social interactions (1). EP can also increase our understanding of human emotions and why we have them, our ability to perceive the environment we are in, and even personality. While these provide for interesting reading, one stands out the most (1). Crime is a complex occurrence, and theories have struggled to explain its presence in modern society (1,2). We can begin to describe the presence of crime by appreciating evolutionary adaptations that cause the behaviours. There might exist an evolutionary advantage for these behaviours to be present because it affords individuals an increase in their reproductive success as well as a greater access to resources (1,2).

This may also suggest why men tend to display more aggressive and criminal behaviours because of the reproductive competition they face from their own sex (1,2). We can take our understanding of crime within an EP context and begin to explain the crime rates in various areas (1,2). It can be said that perhaps EP isn't best suited to be describing crime, but as such a theory is useful in two ways (1,2). The first is that in most societies in human history there is a rejection of antisocial behaviours within them. The notion of agency and independence is important for society and therefore it isn't acceptable to impede upon. Secondly, the behaviours that have underpinned criminality have been present and consistent for a long time. Durrant 2020 states that it is important to explain the phenomena and not just the data (3). In this, they mean that we need to understand why crime is heavily associated with offenders' sex, age, and socioeconomic status. Homicide statistics show that men are more likely to commit homicide and be victims of homicide (2). Evolutionary theories can help us understand these differences by suggesting that men have faced increasing sexual selection pressures i.e., less male parental investment, increased reproductive rates, and variability on the success of reproduction might have brought about aggression, dominance, risk taking, physical traits, and the pursuit of social status (2). Women on the other hand have not had to face these selection pressures and therefore have not adopted the traits that would explain aggressive and antisocial behaviours (2).

If we can use evolution to explain crime, can we use it to also explain violent crimes such as homicide? The literature is divided on how evolutionary theories can explain the presence and prevalence of homicide. Daly and Wilson have argued that homicide is a by-product of our evolved mechanisms that are not necessarily adapted for this purpose (3).

They further state that there is no evolved psychological concept of homicide, but do not rule out the possibility for this to be true. On the other hand, Duntley and Buss have proposed that there may exist an evolutionary adaptation that does explain homicide and is more than just being a by-product of evolution (4). Because homicide is a powerful strategy with dramatic costs and benefits to the individual it could be subjected to evolutionary pressures and selections. The authors purport that in weighing up the fitness costs and benefits of committing homicide, the benefits might outweigh the costs (4). They claim that benefits of homicide include gaining access to a rival's resources, eliminating an intra-sexual competitor, and gaining access to mates (4). Conversely, the risks include damaging their social reputation, and getting injured or killed themselves. The dichotomy of these influences the selective pressures and have created our psychological understandings of homicide (4). From this they put forth the Homicide Adaptation Theory to explain the presence of homicide. This theory provides explanations for sex differences in homicide where they consider that women generally have not adapted homicide traits because of their access to mates and have been faced with selection pressures to invest in the development of their infants (4). Homicide Adaptation Theory also suggests that infanticide has come about because there existed a need for the forgoing of maternal investment in the infant to preserve her resources. Duntley and Buss report that while homicide strategies have developed because of evolutionary pressures, they suggest that the individual is capable of not selecting this strategy (4). Moreover, it is not the only strategy that exists to solve problems by the individual but that it is just one strategy that an offender can use. There can be intervention from a multitude of other factors that stops them from using homicide as a strategy up until the point that complete the crime (4). Evolutionary Psychology can help explain why crime is present within human society, and how crime is thought to develop.

### *3.1.2 Affordance*

Affordance was first brought to the fore by Gibson in 1979 who proposed that affordances are things that the environment offers the 'animal'. Wortley further states that these affordances are things that can be used for both good or bad, but that there is a complementary relationship that exists between the environment and the animal (5). In this definition, the term animal includes humans and environment is the world in which we live. The easiest way to think of affordance is considering what a flight of stairs may offer to us as humans; in this case stairs are something that can be used to climb to reach new heights. It can also be used to sit and rest if need be. The affordance exists even though not all animals can use it, for example infant humans aren't able to climb stairs. The needs of the animal, and their perception of the environment, dictates the affordances that are available to them. While affordance seems relatively straightforward there is within it a rich complexity that needs to be appreciated, and the literature has moved on from Gibson's broad definition (5).

In 2014 Rietveld and Kiverstein proposed that affordance is indeed much broader than originally thought, and the possibilities that exist within the environment are greater than first imagined (6). As previously mentioned, how an individual perceives the environment is critical to the affordances that are available to them. Furthermore, the ecological niche that the individual is in is also key. To survive in the niche that humans have created, Rietveld and Kiverstein argue that specific skill sets have needed to be created (6). This is true for any organism in their environment, each have had to develop necessary skills to survive, and it is these skills that help them make use of the affordances. For humans, our skills created from our niche have been developed from our higher-level cognitive abilities. The skills that are learned help locate the affordances that are relative to the individual and their specific needs.



In this frame of thinking, Rietveld and Kiverstein propose that affordances are relative to a “form of life” and are specific to that form, which differs from Gibson’s broad theory relating to a “way of life” (6). As previously discussed, it is important to think of affordances as relative to the skills that a form of life possess, but the literature has also begun to question whether affordances can invite or solicit behaviours (7). Withanage et al state that there is an inter-relationship between individual behaviours being directed at the environment and the environment being directed at the individual. The authors incorporated the theory of agency to help determine why/how affordances can invite or repel behaviours. The authors argue that the individual/animal is in control of their own behaviour, as is set out by their agency, but these behaviours are in part regulated by the affordances that are in the environment (7). Furthermore, these behaviours are based on the possibilities that exist in the environment due to the presence of these affordances (7).

Because of our agency, it is up to us to determine what affordances are actualised. The authors introduce the field of affordances captures how a collection of affordances invites an individual in a certain setting. The landscape of affordances involves all affordances available, whether they can be perceived or not, and agents can deliberately decide to perform an action. The individual can, depending on their needs, resist affordances that are irrelevant to them if they do not meet their needs (7). The work of Heras-Escribano and Pinedo-Garcia further expounded on the relationship of affordances and the niches in which they arise. They offer agreeance to what Withanage et al described in the previous section but place more emphasis on the evolution (8). By this they mean that the affordances have evolved based on the niche ecological setting they are in, and this in turn is influenced by the socio-cultural practices that humans have developed from an evolutionary perspective (8).

The work done by the authors attempts to transform our understanding of affordance by merging competing areas into one well-rounded theory that considers how evolution has moulded the niches that we have (8). Our behaviours in relation to the affordances in the environment solicit certain actions from the individual (8).

Keatley briefly discussed affordances in a criminological perspective to ascertain how criminals navigate body disposal sites and other crime scenes (9). They begin to question the affordances in the environment and how these are reflected in the decision-making process, especially regarding the sequence of events (9). Specifically, they postulate that perhaps an offender chooses a particular waypoint in and out of a scene, and that they may be random or not random at all (9). Based on the previous discussion, it can be postulated that based on the skill set of the offender, and their specific goals, the environment offers them affordances to commit their crimes. The criminal then would either knowingly or subconsciously follow these affordances in acting out these crimes, which fits with the notion that the relationship between behaviour and the environment invites the specific behaviour (6,7,10). The offender may be more keenly attuned to these specificities of the environment than an individual who has no criminal intent (10). The research suggests that just because the individual does not pick up these affordances in the environment, it does not mean that they are there (6,7,10). Affordances exist in the environment regardless of the perceptive abilities of the individual, they just need to be perceived (10). From what has been highlighted about affordances, we can start to incorporate these into a criminological setting. If we think of the interactions between the affordances in the environment and the offender, it might highlight key understandings about how offenders use the environment to commit their crimes. This could be reflected in the way the individual moves about a location when they are undertaking their victim selection processes.

Offenders could be drawn to specific areas based on the characteristics that exist i.e., dimly lit area, away from the public eye, or an area where their victim's gather. Furthermore, the offender may choose a specific location to bury their bodies that has relevant characteristics such as particular access and egress points, an area that aids to conceal their bodies such as bushland areas away from the public. The offender may be more keenly attuned to the specificities of the environment because of the way that they use it, which in turns aid in their committing these crimes.

### *3.1.3 Satisficing*

Satisficing can be best described as a decision-making heuristic in which the individual searches through options that are in front of them and choose one that is the most acceptable (11). Simon originally introduced the concept of satisficing in 1956, and the term is a portmanteau of satisfy and suffice (9). Simon posited that decision makers “find the optimum solution for a simplified world or a satisfactory solution for a realistic world” (11). Both occur at the same time, and there isn't one that is more dominant than the other. The decision that is made isn't necessarily the best or most optimum, but the one that meets most general criteria. In 2016 Beck et al reiterated the concept that real life decisions are heavily bounded and face several limitations (12). Such limitations include a lack of time to devote to deciding and the cognitive processes behind these, as well as being faced with uncertain information. Satisficing comes to the fore as a heuristic that overcomes these limitations by choosing to focus only on certain information and ignoring other factors (12). Satisficing also leads to a “good enough” approach that satisfies internal decision-making criteria. Beck et al suggest that there is little research done to determine how satisficing is triggered (12).

What is known is that when faced with familiar problems people choose decisions that are memory based, whereas when faced with uncertain information people try to find correlations between information that is presented (12). The authors conducted research to determine what factors influenced the decision-making process by subjecting participants to varying time pressures. The research showed that when the participants were faced with increasing time pressures, that they 'dropped the worst' informational cue to adapt to the constraints (12). By selectively choosing to ignore these cues, they maintain the "good enough" approach that is present in satisficing. In doing so, this reduces the time and effort spent cognitively analysing the information. These findings support the claim that satisficing is employed when individuals are faced with time pressures as well as being presented with uncertain information (12). How do the people that use satisficing feel about the decisions that they make? And to what extent is there a difference between satisficers and maximisers in relation to their subjective evaluations when faced with these decisions? Saltsman et al attempted to answer these questions by exposing their participants to a variety of questions and measured their cardiovascular responses as they answered these questions (13). The literature suggests that there exists those that are 'maximisers' e.g., the individuals who try to find/select the most optimal decision, and those that are 'satisficers' i.e., those that put in minimal effort in their decision-making processes to select the most satisfying and sufficient for them (13). When faced with a large selection of choices, people often encounter choice overload which purports that those who are faced with a large selection of options are less happy with their choices, but this is dependent on whether they satisfice or maximise (13). Saltsman et al suggest that the literature shows that this is partly due to the extra time and effort that maximisers utilise compared with satisficers who tend to reduce this time and effort.

This is partly due to the extra time and effort maximisers put in to make their decisions, whereas satisficers only put in minimal effort to find their options that suits their criteria (13). This differing range of effort might be due to maximisers have no time to make their decisions and satisficers might feel less capable in their abilities to make decisions. The authors tried to determine if there were physiological based differences in these groups that might be present that would support if satisficers feel less capable or tend to value their decisions less or if maximisers valued their decisions more (13). They found that there were no cardiovascular responses that suggested that either group valued their decisions in a marked way, which may refute the claim that satisficers do not care about their choices (13). However, the authors determined that there were physiological responses that suggested that they did feel less capable of making decisions when faced with choice overload. Furthermore, their research suggests that satisficers were more satisfied with their decisions when they were asked to self-report how they felt. Saltsman et al also noted that if an individual was faced with the inability to reach a decision, they both resorted to satisficing strategies to overcome this (13). Luan & Li expound on the concept of satisficing by introducing that it might include two key factors that influence it: *desirability* and *feasibility*. As previously shown, satisficing is an essential component in decision making but how it works in practice is not fully understood. In the real world, choosing the best option all the time isn't realisable as decision-making skills are limited by biases that affect the cognitive processes (14). Therefore, satisficing fills this void by picking the 'good-enough' option. Being able to always pick the best option is not realisable due to the limitations of the human cognition therefore satisficing helps people choose a good enough option (14).

Desirability and feasibility are important in that they both aid the understanding of choice preferences: where *desirability* describes and determines the value a choice has, and *feasibility* regards the effort that is required to achieve the goal (14). What isn't clearly known is whether satisficers settle for their 'good-enough' option because they place reduced value on the choice or if it because they want to expend the least amount of energy. Luan and Li, in their research, showed that there are differences exhibited between both maximisers and satisficers (14). Maximisers value both desirability and feasibility, whereas satisficers are torn between the two. Satisficers aim to minimise the effort they put in and show an affinity towards the feasibility of the goal/choice than do maximisers who incorporate the two (14). Furthermore, satisficers often make choices to satisfy themselves and maximisers tend to make choices that are influenced by social pressures (14). Dando and Ormerod attempted to understand the decision-making process police investigators go through by analysing their decision logs. These decision logs are important part of policing as officers in the UK are required to log all choices that they make, which leads to how investigators generate their theories and determine what evidence to collect (15). They looked at the biases that are present in the cognitive process that might influence the decisions that are made, and they incorporated satisficing. From what has been shown so far in the literature, this might lead investigators to choose a less optimal decision and come up with less optimal theories about the crime (15). The authors highlight police only generate 50% of all possible hypotheses yet were convinced that they had exhausted all their possibilities. They also demonstrate that more inexperienced officers tend to fixate on a single hypothesis instead of considering all options (15).

Furthermore, that time pressures played a more significant role on hypothesis generation than experience. Their research found that more experienced officers were able to avoid satisficing and other confirmation biases than their less-experienced counterparts, where they are more susceptible to satisficing (15).

Keatley et al examined satisficing in the context of how burial sites are chosen and how this heuristic affects criminals carrying out their activities. They discussed this topic in a series of theories relating to Winthroping and what psychological and criminological determinants might be present (9). They posited that some criminals may choose to carefully plan how they will dispose of a body and pick a grave site, however satisficing might come into play when they are faced with scenarios that are uncertain and require them to make a split-second choice (9). The authors suggest that these uncertain scenarios might be any event that stops them from reaching their desired plans. They also suggest that satisficing might take place on some level when the offender must locate a grave site, and that even with strategic planning, satisficing might be employed (9). Satisficing might guide investigators in locating hidden sites, as this heuristic might reveal itself in the sites that are chosen and their locations. They note that grave sites are often chosen near vehicular access and downhill, which relates to the least effort maximum gain paradigm (9). Based upon the literature it seems offenders who use satisficing strategies might be more likely to be disorganised killers whereas organised killers might display maximising strategies. This hasn't been explored in any research to date, however satisficing strategies are likely to be employed by both types of serial killers, as well as individuals, in the face of extreme time pressures and the uncertainty of the cues they are receiving from the environment.

## 3.2 Environmental Criminology

### 3.2.1 *Geographical Profiling*

Geographical Profiling (GP) is an investigative technique that aims to determine the location of the offender in relation to the crimes they have committed. One of the strengths of GP is that it is designed to synthesise information to generate hypotheses about the offender (11,16,17). Furthermore, the use of this methodology can help elicit information about the offender's spatial behaviour i.e., the movements they make within the crime location and how this leads to decisions they make. GP was developed in the 1980's originally as Circle Theory from Canter and Gregory before being refined by later research into the area. The ability of GP to determine offender's spatial behaviour is based on knowledge generated from the fundamental theories that form it. GP combines the theories from Crime Pattern Theory (CPT), Routine Activity Theory (RAT), and Rational Choice Theory (RCT) (11,16,17). Each theory will be discussed in detail; however, the key message is that these theories determine that an offender's crime is related to the locations in which they live. Moreover, the offender and the environment have a unique relationship with each other. The theories that form GP also have potential use in explaining clandestine grave location choices as Keatley et al reported (9).



### *3.2.2 Rational Choice Theory*

RCT is defined as a heuristic device that offers a way of looking at offending that recognises the immediate influence of the environment on behaviour (5). RCT has dual use in both economics and EC. In both contexts RCT attempts to explain behavioural patterns and decision-making choices which are then used to predict behaviours and decision-making choices (5,11,17). Decisions are based on a cost/benefit dichotomy that determine what choices are made by the individual (5,11,17). Early EC research in 1970 focused on the prevention of crime, but the research neglected to explain the failure rehabilitation efforts of offenders in the United States of America (5,11,17). Cornish and Clarke developed RCT and proposed that it could be used to explain offender's behaviours and decision-making to explain why they commit crimes (5,11,17). They further stated that the environment plays an important role in the facilitation of crime because it directly influences individual's behaviours (5,11,17). There are 6 key tenets of RCT with the first considering that crime is purposive (5). This is meant as that crime directly benefits the offender because it satisfies their motives. Secondly, crime is also rational, but more importantly that it is boundedly rational. This is because while it may not make sense to outsiders, it makes sense to the offender and influences the choices that they make (5). Thirdly, criminal behaviour is crime-specific because crime requires specific skills and behaviours depending on what type of crime they commit (5). Fourthly, criminal choices are based upon two kinds of decisions: involvement and event decisions. Involvement decisions relate to the offender's background and event decisions are relating to actions during the crime (5). Fifthly, involvement in crime can be separated into three stages. Initiation is influenced by experience and background. Habituation relates to the decision to continuing or stopping offending (5).

Desistance relates to the lack of success in committing crime which leads to the reduction in frequency. Lastly, criminal events unfold in a sequence of stages and decisions (5). Within Cornish and Clarke's work there is a theme of the emotionality of crime and the importance to consider how this effects criminal behaviour (5). Therefore, it is important to consider that crime isn't an emotionless occurrence, and it reflects on the type of crime that is committed i.e., sexual assaults, homicide, burglary. Emotions form the key part of motivating the individual to perform certain tasks because they reflect desires and wants. Simpson introduced the impact that emotion has on crime and put forth three key roles it plays within RCT (18).

The first considers that emotion is important in the context of rationality. Negative emotions potentially exert their influence on the individual by reducing rationality and making it bounded. It may also mean that there are more impulsive actions. Secondly, offenders might weigh up the thrills of committing a crime against the risks and choose to commit a crime because of the emotionally benefits they might receive (18). These thrills exert their influence on the decision-making process. On the other hand, the emotional costs of committing crime might effectively reduce the likelihood of it occurring as it might deter some offenders from committing their crimes (18).

Analysis of serial murders and disposal site location choices by Lundrigan and Canter in 2001 show that any locational choices require specific decision processes (19). The way in which an individual interacts with the environment is influenced by spatial processes that are shared across all individuals (19). While spatial patterns might be shared across these individuals, how they influence the commission of the crime varies. The criminal is driven by motives that are unique to them, but how the environment, and perceptions of the environment, is generic and reflects in their spatial behaviour (19).

Violent and emotional crime should be thought of within the same logical models that are used in predicting burglaries and similar crimes. The theory of rationality is still important, as these violent offenders still display a sense of rationality (19). The authors discuss two theories and how they may best explain the spatial behaviours of criminals. The routine activity theory and the rational choice perspective. In relation to RCP, the authors suggest that there exists a trade-off between costs and benefits of committing crimes which is influenced by the time and effort that is required to be put in by the offender (19). An example benefit is the emotional gratification, and the cost is the risk of being caught. Offenders are thought of as behaving rationally as they see it at the time of the crime, but this rationality may not apply on another occasion (19). RAT and RCP differ in that RCP would posit that an offender would travel to an area that benefits their needs whereas RAT would suggest that distances travelling to dispose of a body would be more clearly related to the residential area the offender is from. We can generate some hypotheses as follows: RCP would lead to disposals occurring at a greater distance from the home than RAT. RCP would lead to a greater variation in areas that criminals choose to offend in based on the resources available to them. RAT would lead to more bodies being disposed of in areas they are comfortable with. RCP would suggest that disposal sites are distinct locations whereas RAT would involve a more random distribution. RCP would explain offenders moving between locations to avoid risk whereas RAT would keep the offender in the area.

Beauregard et al were one of the first to attempt to understand the offender's perspective in crime in the 2007 research where they were aiming to develop a descriptive framework of sexual offender's behaviours using RCP (20). They cited that at the time dealing with offenders face-to-face as well as understanding their perspectives involved a great deal of reluctance from researchers (20).

Moreover, the use of a descriptive method in understanding these choices would provide greater information into how these crimes occur and why. RCP was utilised in the questionnaire as a heuristic device and given to known sexual offenders and asked about their crimes in relation to two areas: victim search methods and offender attack methods (20). From their results, they noted that the type of crime that was committed influences the choices made during the crime. Offenders use the environment they are in to manipulate how they encounter their victims, and the authors report that some sex offenders are motivated to commit crimes if they perceive that it might be easy to find a victim, and the victim's vulnerability (20). One offender reported that it was easier to find victims in poor neighbourhoods. Furthermore, some child sex offenders put time into faux relationships with people to access their children which allows greater opportunities to commit their desired offence (20). However, it was noted that some environments provided too great of a risk for offenders to work in which included schools and playgrounds (20). Victim selection is influenced by cues the offender receives from the environment, for one, and they use sets of cues and cue clusters in their decision-making processes. This process will influence the crimes that are committed by the offender and is also influenced by the environment they are in, as some offenders purposefully choose specific environments (20). Some sex offenders choose to ignore environmental and social cues when they attack their victim, and to attack then and there. A third of sex offenders are selective of their location and choose an isolated area to avoid detection. However, such locations reduce their victim pool. For example, according to Beauregard et al, child sex offenders often use their home to commit crimes because it might make their victim more amenable to their crimes (20).

RCT was discussed in the context of body disposal patterns to analyse solved and unsolved sexual homicide cases in Canada. In their research Chai et al note that sexual offenders were often thought of as solely driven by fantasies and impulsivity (21). However, as the literature evolved and time passed, it is more important to consider that there may be some “rationality” behind the crimes they commit. Furthermore, the authors state that child molesters perform an RCT style cost-benefit analysis in factoring in whether they commit their crimes which has similarity to such analyses being used in non-violent non-sexual crimes like burglary (21). To overcome the lack of research in providing a complete picture of the crime and decision-making processes that offenders make in committing sexual homicides, Chai et al incorporated RCP into their research to provide insights on the types of decisions that are made with particular interest on the body disposal patterns (21). The choices that offenders make in relation to disposing of their victim’s bodies can shed light on the offender’s criminal experience level, logical clues to what happened during the crime, and narrowing down suspect lists (21).

Chai et al used RCT to look at body disposal factors in sexual homicide cases and incorporated variables from crime phases to determine whether a body had been moved. Furthermore, they attempted to discover if there were any factors that were different for solved and unsolved cases. The authors found that if the offender moved the body post-crime, they displayed more forensic awareness and more skill in relation to committing the offence (21). RCT can attempt to provide an explanation for this, as the offender would perform a cost-benefit analysis in deciding whether to move the body. The offender might choose to move the body because of the benefits that it provides. The benefit might be that it reduces the risk of detection and allow the offender to continue their crimes. The converse might also be true, where offenders choose not to move the body because of the risks of being caught (21).

RCT can also explain the finding that Chai et al reported that when there was a stabbing the offender chooses more often to leave the body at the scene than to move it. This might be because the presence of blood creates a concern about transporting evidence and therefore presents more of a risk to the offender being caught (21).

### *3.2.3 Routine Activity Theory*

Cohen and Felson proposed Routine Activity Theory in 1979 as a unique explanation of the fluctuations of the crime rate within the US between 1947 and 1974. In this period, the crime rate rose dramatically, but researchers at the time attributed this rise in crime to people willing to break the law (22). However, the authors further expounded on this point and added that there were changes in criminal opportunity at that time which better explain the rate of crime. This was a divergence from the studying of the offender itself, which accounted for most of the research in the area at the time (22). This explanation of crime relies more on the environmental context of the crime itself and how this influences the behaviours. Based upon this, Cohen and Felson introduced a “routine activity approach” to analyse these crime trends (22). The structure of the offender’s routine activities exerts their influence on crime rates and trends within an area. There are three elements to this routine activity theory to which explain the crime rates and they are motivated offenders, suitable targets, and the absence of capable guardians. The removal of these elements is theorised to prevent the crime from taking place. Their work used a human ecological analysis to explain the crime rate changes and that there is a lack of a capable theory to account for these changes (22). Crime rates will increase if there is an increase in suitable targets and motivated individuals and will decrease if either of these elements decrease.

The Encyclopaedia of Criminological Theory suggests that RAT is based on two central propositions. The first assumption is that activities create the criminal opportunities that are present in the environment by increasing the frequency with which the offender and target interact with each other (23). The second assumption is that potential offenders assess the perceived value of the target and in this case also assess whether a guardian is present (23). The benefit of RAT is that it can provide insights into the when, where, and why criminal events take place through this relationship between the elements of RAT. RAT began as a method to describe the movements of crime like burglaries and thefts that are easy to describe, however it is important to show the link that RAT is useful in homicides to explain movements leading up to the crime as well as the geographical relationship between victim and offender locations in homicides (23). Furthermore, it is important to show that RAT is a valid method for assessing these movements.

The research at the time of Pizzaro et al showed that offenders generally live in a geographical area close to their crime, usually within 3.2km (24). Because of this, distance decay exerts its influence in that as this range increases and the offender travels outside it, crime is less likely to occur (24). While the literature at the time understood this, Pizzaro et al attempted to use RAT to address limitations they felt existed. The authors state that little was understood about the mobility patterns of victims and offenders, as well as the influence that homicide motives have on geographical patterns (24). Furthermore, little was understood about offender's reasons for not travelling long distances to commit their crimes. These limitations form the basis for their research in this area by formulating the authors research questions (24). To test these questions, police files from New Jersey were obtained from 363 homicides from 1997 to 2005 and incorporated this into their datasets.

Their findings confirmed that victims and offenders travelled the shortest distances, finding there to be a statistically significant relationship between the two (24). However, distances varied by the motivations for the crime, with offenders travelling the farthest distances to commit gang-related homicides. At most crimes, most offenders and victims didn't partake in much travel. The researchers found that homicides converged in places that both offenders and victims carried out their activities (24). One main tenet of RAT is that for crime to occur, the activities of the offender and victim need to align. Crime is suggested to only occur when there is this convergence in time and space, where without this crime will not occur (24). They also found that offenders are reluctant to commit offences in the immediate vicinity of their home due to the fear of being recognised. They do, however, prefer operating within the geographical area in which they are comfortable, which supports RAT and environmental criminology theories of offender mobility (24).

Spano and Freilich critically reviewed the research into RAT from 1995 to 2005 assessing the empirical validity of the findings (25). This is the first of a kind paper, with little research into RAT. This review article assessed 4 key components of RAT: target attractiveness, guardianship, deviant lifestyles, and exposure to offenders (25). Spano and Freilich highlight the mix of findings that exists within RAT literature, where articles report conflicting findings (25). The authors claim that this could be due to differences in the variables being tested, the sample sizes being using, and the types of crime being assessed. From this, they also aimed to examine the level of correlation between the variables and the 4 concepts introduced in the beginning (25). Their research found that guardianship was 5 times more likely to be a protective factor, and that target attractiveness (3.3x), deviant lifestyles (7.4x), and exposure to offenders (3.12x) were all risk factors (25).



Additionally, studies which included teenagers and college students were more likely to report support for guardianship and target attractiveness whereas if multiple age groups are selected in studies, they tend to show support for deviant lifestyle concept (25). In whole, the literature shows a pattern of support for all 4 factors of RAT and the hypothesised affects that they have. Intriguingly, the analysis uncovered that RAT may be more applicable to the USA as little research has been conducted outside of the US assessing how RAT is related to crime (25). Furthermore, they suggest that further research be conducted into RAT and child homicides because of the potentially blurring of who the motivated offender and the capable guardian is.

According to Groff, RAT's key issue is that it has faced problems with being able to be reliably tested, with research finding that it is difficult to collect data in relation to its key tenets (26). Furthermore, Groff highlights 2 key limitations of RAT, being that there is a lack of individual-level data as well as the inadequacies of current techniques in modelling crime patterns (26). This in turn causes there to be ecological fallacies in trying to correlate behaviours exhibited in a geographical area to the individual, which is most common with using macro level modelling. By using agent-based computer simulation modelling, Groff sought to better explain the spatial-temporal structure of the routine activities of offenders and how the convergence of these activities in relation to their targets can be explained (26). To test how well these computer modelling strategies in validating RAT, Groff focused on burglaries to test the hypothesis that the more time individuals stay away from home the higher the chance of robberies occurring (26).

This is reflected in RAT which suggests that time away from home is correlated with increase in crime. Assessing crime statistics from Seattle formed the basis for the computer modelling, with the results confirming that crime did increase when individuals spent more time away from home, backing up the notion put forth by RAT (26). Groff found that while there was some fluctuation in robberies, there was still a significant level of correlation between time away and likelihood of offending. Interestingly, Groff showed that hot spot policing was an effective method to reducing the crime rate in areas of high crime. RAT suggests that the level or presence of guardianship influences the offender's decision to commit a crime, which reflects on the finding that Groff reported where hot spot policing could be effective (26).

The contrariness of the findings RAT has produced was also cited as a reason for conducting research by Vilalta and Fondevila where they introduced RAT into a Mexican context (27). This is one of the first conducted in Latin America, and indirectly follows on from the findings of Spano and Freilich who suggested that RAT may not be applicable outside of the US because of a lack of data. (27) By using RAT to explain robberies in Mexico, they are also simultaneously testing whether this theory could be useful in understanding the crime rates in Mexico and its predictive capacity (27). To assess this, they used findings from a national survey on crime and victimisation which consists of interviews and questionnaires from 108,000 dwellings. The authors found that exposure to motivated offenders was the strongest predictor of burglaries in residential areas, but conversely found that target attractiveness was the least correlated with this type of crime (27).

The authors also found that neighbourhood attractiveness was a key feature of robbery, with areas that have low water supply was a negative indicator of burglary. In this context, while RAT was useful in aiding the analysis of crime data results tended to favour the neighbourhood specific factors. Due to this, the authors suggest that there is a complex multi-level relationship occurring that influences burglaries (27).

### *3.2.4 Analytical Methods in Environmental Criminology*

#### *3.2.4.1 Spatial Analysis*

There is a multitude of literature on spatial analysis within criminology and can be thought of as an extension of all the criminological theories in the literature. Spatial analysis is a way of quantitatively testing these criminological theories and assessing their accuracy in what they state about why crime occurs. Andresen poignantly considers the notion that human behaviour is situated in place, and it can be logically concluded that crime itself is situated in geography (28). Spatial analysis has aided our understanding of crime by subsequently narrowing down where it occurs in specific areas within communities: from city level to town level, to neighbourhood level, and even to the street level (28). The development of the discriminating power of spatial analysis started in 2000 where Smith et al integrated Routine Activity Theory and Social Disorganisation Theory in a city-wide analysis of robberies (29). They highlighted that there are spatial stressors, or geographical stressors, that also influence the behaviours of individuals to commit crimes and that by understanding these contexts our understanding of why crime occurs will be enhanced (29).

Smith et al found that robberies occurred on streets within neighbourhoods that are disorganised and that robbers diffuse from their residence and offend in areas where they have routine activities (29). Robberies will only occur on streets that tend to be familiar and best explained by RAT. Furthermore, the authors noted that further research make use of street segments to act as the spatial unit of analysis (29). Because of this finding, it generated more research into street level analysis where in 2004 Weisburd et al found that crime was concentrated on only 5% of street segments but accounted for 50% of all offending locations (30). This led to the conclusion that crime is clustered where street segments showed the greatest detail of this (30). Andresen and Malleson backed up the street level findings by noting that the spatial distribution of crime is more noticeable at the street level and that distribution trends are distorted when using larger spatial units of measurement (31). The findings also back up the assumptions that are set out in RAT and RCP, noting that these theories are best placed to guide understanding of crime where they can explain why there is convergence of crime on one street and not the other (31). Andresen and Malleson succinctly state that changes in routine activity correlate to a change in crime (31).

Spatial research tends to be conducted on static crimes like burglaries, thefts, and robberies, where the literature suggests it is easier to account for the crimes because of the relative lack of complexity of these crimes. More violent crimes, like sexual assaults and homicide, are highly complex and harder to define. This is not to say that spatial analysis is not suited to these kinds of crimes, but more care needs to take place. Smith and Sandoval analysed homicide rates in St Louis by comparing two different scales to test the better predictor of homicide rates (32). They utilised a traditional census tract scale, which is a meso level scale, and a 1km grid scale which is micro scale.

The authors concluded that there were indeed differences in the scales where the census tract better accounted for social and economic determinants of homicide whereas the 1km scale was able to detect subtle differences in geographical areas (32). Pereira et al assessed the spatial and temporal influences that might affect homicide rates in a Brazilian city (33). In this, they compared two theories Routine Activity Theory and Temporal Aggression Theory as a possible explanation of homicide rates in this city (33). While they did not find any support for temporal aggression, in their spatial analyses they found strong support for RAT. They reported statistically significant differences in homicide rates in relation to the time of day and the day itself, where crime tended to occur more at night-time and more on the weekends (33).

#### *3.2.4.2 Behaviour Sequence Analysis*

Behaviour Sequence Analysis (BSA), or simply sequence analysis, is a statistical method useful in highlighting transitions between behaviours and events. In relation to spatial analysis, BSA can be thought of as the assessment of individual behaviours and the sequences of these whereas spatial analysis is more concerned with a higher-level group functionality of a particular geographical area and assessing the data from this. Where spatial analysis may struggle to account for crime at anything smaller than the street level, BSA can be used to examine individual behaviours at a micro level which can inform what then happens at a greater level. As Keatley et al in 2020 put it, sequence analysis is more than studying individual risk factors BSA is more concerned with studying the transitions between these factors which is useful when looking at developmental trajectories (34). Ivanouw studied the theoretical and methodological applications of sequence analysis in 2007 in applying it to psychological research (35).

The author incorporates this technique from the Markov model that is used in genomic studies in DNA analysis. Moreover, Ivanou highlights the limitations of current psychological research suggesting that it requires most observations be independent of each other (35). Sequence analysis may perform better because it considers that variables are not independent of each other and accounts for this (35). Sequence analysis was used in analysing the behaviour dynamic between offender and victim in rape cases, specifically interested in the victim's perceptions of the interaction (36). Ellis et al emphasise that at the time there was competing ideas about rape victims' behaviours and note that sequence analysis could be useful in understanding the complex nature of these behaviours and revealing any patterns that occur (36). Based upon the results, Ellis et al support research findings that if there was resistance on the victims' part then this would lead to aggressive responses from the offender (36). Their findings also suggested that perceptions of rape were based on preconceived myths about what might occur in a theoretical rape, however these findings could be used for educational purposes (36).

BSA was employed in 2020 to synthesise large amounts of data gained from serial killer's life histories to identify relevant patterns and factors that influence what made them kill (37). In doing so, Keatley et al revealed significant behavioural events that were similar across the killer's life histories. From their results, the authors highlighted several themes. Parental abuse was reported to be present in most cases because of this analysis and this is reflected in the literature which states that parental abuse is a key indicator of homicides (37). The findings also confirmed the view that females tend to be highly victimised which appears in homicide trends around the world (37). Other results included the presence of criminal history and past offending, as well as modus operandi of the offenders, in which BSA can be used to predict trends and used by investigators to assess patterns of crime (37).

Most recently in 2021, Keatley et al used BSA to explore the dynamics of stalking by understanding how the behaviour starts and continues (38). Commonly, stalking behaviours are grouped together to identify patterns or thought of as isolated events. The aim of their research was to provide new insights into stalking behaviours and perceptions, and in doing so showed that predicting stalking behaviour is a difficult task (38). The authors found that there were many different starting points for the behaviour as well as finding that the behaviour was hard to deter even when the victim tried to deter the stalker. The authors also found that stalking behaviours should not be separated from offline versus online behaviours, where in doing so the complexities are missed (38). This is because offline stalking often included an online component and formed a key part of the offender's steps in stalking. This is different to what the literature suggests in that they should be grouped differently (38). Keatley et al describe the power of BSA as being able to contextualise large amounts of complex data and glean from this patterns and trigger points in behaviours that may indicate escalation (38).

#### *3.2.4.3 Matrix Forecasting*

Forecasting proper is a method by which crime data is analysed on a specific location and is used to predict where crime might occur based upon the patterns that emerge. Such forecasting methods have been used to predict where robberies, burglaries, and drug related offences occur and direct policing responses to the areas that need it the most. Forecasting can also be used to analyse trends whereby fluctuations in crime rates because of urbanisation or other factors can be assessed and help police prepare for these changes by developing warning systems (39).

Rosser et al used forecasting at the street level in exploring property crime trends and found that such forecasting improved predictive accuracy of this type of crime analytics where they uncovered 20% more crime at various levels (39). This kind of forecasting occurs on the macro scale, looking at crime in specific areas and jurisdictions to help generate the data used by the models. There is a plethora of research on forecasting in relation to spatial crimes, but few methods of forecasting on the individual committing the crime. It is therefore important to appreciate how forecasting is applicable to criminology before making the move to the individual level. Furthermore, forecasting is often used retrospectively in assessing crime trends whereby historical data is analysed to provide insight into how crime can grow and transform. In a systematic review of spatial crime, Kounadi et al note that crime is not random and therefore can be studied (40). This includes the spatial component of the crimes themselves. Moreover, the state that there has been a significant increase in the use of spatial forecasting as well as the increase of the methods used (40). Because of this, the authors determined that there was a need to analyse the methodologies currently in use to determine their significance in predicting crime. In their review, they highlight specific methods that are more suited to this forecasting and conclude that forecasting is a powerful tool that was aided by the introduction of a spatial component to it which helped increase the predictive power of crime (40). On the other hand, the authors also mentioned that such forecasting methods have generally only been applied to property crimes which has led to an imbalance in the literature (40). Such an imbalance could be overcome by using forecasting methods for other types of crimes e.g., homicides.



Forecasting methods have been developed over the years, where De Bruin used a data mining technique to cluster criminals based on the investigative profiles created on them (41). Such a clustering enabled them to identify specific classes of criminals as well as uncovering important factors that influence the analysis of criminal careers such as the frequency and duration of the crime (41). In creating a matrix for this analysis, the developed a distance measurement and combined it with the difference in profiles and the changes of criminal behaviour overtime to assess the variation of trends in criminal careers (41). Alternatively, Abraham et al used computer log files to discern the criminal's behaviour (42). By using the computer files, they generated profiles based on the frequency of incidents but noted that crimes could be influenced by globalisation (42). Data mining to forecast behaviours and crime trends is not without limitations, where there are concerns about how the data is collected as well as how the data is analysed (42). To successfully do it one needs to be skilled in technology as well as have a significant background in criminology. Moreover, as Thongtae and Srisuk explain there is no guarantee that data mining is best suited for criminal investigations (43). These issues might be solved by a method that relies on understanding the decision-making processes of offenders and how this influences their behaviours when committing crimes (43).

Keatley and Clarke used matrix forecasting as a novel approach to aiding investigators to solve cold case crimes, where they cited that such an approach would provide a rationale for understanding the decision-making process the investigators used during now cold cases (44). Several policing techniques that help guide investigators through the policing process are subject to biases which can unintentionally affect the investigative efforts.

Therefore, Keatley and Clarke suggest that by using matrix forecasting, it would enable the cold case reviewers reanalyse evidence as well as understand why the case went in the direction that it did (44). Furthermore, matrix forecasting would highlight potentially any biases that are present during the investigation. Keatley and Clarke also suggest that typical statistical approaches lack in their ability to understand complex behaviours that change over time (44). The authors employ a qualitative approach, that is based on machine learning, to review specific cold cases to highlight the benefits that matrix forecasting has: that is, it enables detectives to forecast “what happens next”. They combine this matrix forecasting with a behaviour sequence analysis approach providing an added extra layer of discriminating power to analyse specific behaviours that can be sequenced together and mapped to highlight patterns and trends that emerge (44). The employed this combined approach to the real-world case of Jeffrey Macdonald. Because this case garnered a lot of conflicting opinions from the investigators, as well as differing accounts from the offender, this forecasting approach clarified the sequence of events that took place during the homicide (44).

From the evidence at the scene the authors generated a simplified sequence of events to show what happened during the murders and clarified specific steps that the evidence suggested Macdonald took. In doing so, the authors claim that this process if conducted at the time of investigation may stop cases going cold as it can merge competing ideas into one uniform theory (44). Matrix forecasting was theorised in Keatley et al as the method in which Winthroping can be developed and analysed. This is a relatively new technique, but as the authors describe, it could be particularly useful in predicting behaviours and forecasting future events.

The fundamentals of matrix forecasting in this context would be to map out the decision-making process into a series of steps, where an idea is presented and then worked through the forecasting stage to predict outcomes from this. The researchers note that by using matrix forecasting in identifying clandestine burial sites a decision-making pathway could be developed to understand why killers choose some locations over the other. Matrix forecasting has not been validated as a tool for use in this context, with the authors only providing a theoretical underpinning for the method.

### 3.3 Forensic Archaeology

The Forensic Archaeology section provides a detailed overview of the events that occur after the body has been disposed of, including biological events that lead to decomposition, as well as methods to find clandestine graves that are commonly used by investigators. In this section we introduce Winthroping as our novel technique to locate these graves, which provides insight into an alternative methodology that could be incredibly beneficial.

#### *3.3.1. Overview of Clandestine Graves*

Clandestine graves can be defined as a burial site that has the intention of concealing human remains, which usually has the purpose of avoiding detection by the individual burying it in this way. At the crime scene of a potential burial site the task of the forensic investigation is focused on finding these burial sites by looking for clues in the environment as well as forensic techniques that can be employed (45-49).

While there are many types of areas that are searched for these remains, this section is focused on open and obstructed areas and not submerged burial sites (45-49). In this instance, open areas are defined as places that include fields, backyards, or anywhere that provides a complete 360-degree view of the area (45-49). Obstructed areas are in places that are wooded, or residential areas with buildings around that partial obstruct the view. The process of finding these burial sites and excavating them is guided by forensic archaeology (45-49).

### *3.3.2 Planning the Search*

If we consider burial sites can be discovered by chance, where a passer-by discovers a remain/s, or revealed to investigators during their interview, it can make this process a lot more efficient and narrow the search efforts considerably (46-50). On the other hand, offenders may not be so willing in revealing the location of the body and burial site as a self-perseverance strategy. In either scenario, it is important to develop a proper plan to find these sites (46-50). Hunter et al states that no two searches are alike because of the differences in circumstances surrounding the burials, however common approaches are taken to discovering them (47). Part of the planning strategy for finding these sites can rely on information from the offender, as previously mentioned. Furthermore, we can also understand the behavioural approaches of the offender in narrowing down where to look (47). The literature is vast with knowledge about disposal sites, where it is known that the offender tends to bury the victims in areas that help them avoid detection and to carry out their crime (47). The areas offenders choose falls into two types: known and unknown. Known areas allow for time to be taken in disposing of the body, whereas unknown areas involve hasty disposals.

Moreover, disposal sites are often thought to be located downhill and close to vehicle access points, although more research needs to be conducted to prove this (47). Prior background work can be done to prepare for the work to be conducted at the scene, where Dupras et al discuss the need for maps and photography of the area in question (48). In the case of large areas, geographical and topographical maps are important in understanding the natural boundaries of the area as well as the terrain. Such maps can also highlight any changes that have occurred overtime, when dealing with a disposal site that is of considerable age (48). Hunter et al poignantly mention that any search strategy employed must consider the logistical efficiency of the strategy at hand as well as the presence of specific experts who can lead the efforts (47).

### *3.3.3 Search Strategies*

While there are a vast range of search strategies, this section will consider the ones often employed by forensic investigators. Searches can be divided into non-destructive and destructive techniques, where we will consider non-destructive approaches first. Dupras et al consider 3 main approaches to visual searches: line, grid, or spiral (48). Each of these have their own advantages regarding scouring areas. Strip pattern searches can provide up to 100% coverage if performed properly because they are conducted in a straight line up and down the relevant area. Members are positioned close enough so that their visual search areas are overlapping (48). While this process depends on the size of the area, in general the members will walk in one direction together then do the opposite direction flagging areas of importance along the way (48). Grid searching starts initially in the same vein as line searching but deviates at the end of the search, when a second round takes place perpendicular to the start point of the first walkthrough (48).

The main advantage of this being that multiple angles are viewed as well as being able to see surface changes from different perspectives (48). Lastly, a spiral search may be conducted if the area is small enough. In this method, members walk around in concentric circles and is useful in finding remains that may have been moved due to animal activity (48). Mapping strategies also form an integral part of the search strategy relating to forensic activities. Geographical Information System (GIS) mapping is a digital tool that represents the landscape as a digital map that can be adapted to suit specific needs. Elmes et al state that the use of GIS can be important for understanding the geology of the area including terrain and soil types as well as visualising access points and changes in topography (44). GIS can inform the use of 3D digital terrain model (DTM) which allows for the mapping of contours in the environment (44). The benefit of DTM is that it allows greater visualisation of roads, slopes, and tracks that are present in the environment. Forensically, these techniques are useful because it allows areas that are concealed from roads and buildings to be visualised and vehicle access points to be discovered (44). Geophysical methods can also be employed to discern differences in the terrain. Tools like Ground Penetrating Radar (GPR) are useful because they can detect changes in soil composition to detect the presence of remains (44).

### *3.3.3.1 Winthropping*

Highly relevant to this section on locating graves is the concept of Winthropping and how it relates to potentially being able to find clandestine graves. In the literature it is under researched with only a few articles exploring the technique. Winthropping has origins in counterterrorism, with the police in Northern Ireland creating it to discover clandestine weapon caches (9).

Winthroping has also been used by the British military during the conflicts in Northern Ireland in the 60's to the 90's where they used this method to locate IRA terrorist items. The method relies upon the assumption that the offender's choices in picking these locations are not random and it is the lack of randomness that investigators can exploit to find them (9). The choices are influenced by environmental features, or landmarks, that exist that help guide the individual to relevant areas that they can conceal items. The decision-making process is influenced by these landmarks as they will assist the individual in finding them again later. This relatively straightforward process can be translated to forensic investigations to help authorities find clandestine grave sites and body disposal sites. The choice of grave site is important to the offender as they will use it to avoid being caught as well as remembering where they left their victim (9). In the dearth of literature on Winthroping, the first instance of its potential use came by way of a research poster that suggests there was a plan to use Winthroping to find clandestine graves by understanding the environmental landmarks however they have not followed up this research in the 10 years since this poster was released. Moses introduced Winthroping to forensic archaeology seeing a potential for the technique to be used in helping forensic archaeologists locating hidden grave sites in homicide investigations (50). Winthroping is one technique they discuss as potential new methods for developing more accurate search strategies (50). This forms part of a larger feature-focused search strategies, which have developed our understanding of locations where bodies can be buried and often include hidden areas that shield offenders from their activities (50).

Following the least effort principle that guides search strategies it is known that graves do not get dug if the soil is too firm or covered with rocks, and not near a natural niche (50). Moses states that is important for forensic archaeologists to consider natural human behaviour when attempting to find clandestine graves and how that influences what sites are chosen (50). Keatley et al grounded Winthroping in psychological and criminological theories (9). They link psychological concepts of affordance and satisficing and the criminological concept of RCP (as discussed above) to explain why offenders might chose the grave sites they do and that Winthroping can be used as a technique to understand these processes. They first suggested that landmarks in the environment affect the mental map that we create of the area and state that natural landmarks like rivers, trees, terrain, and natural boundaries are important features that are used both consciously and unconsciously (9). It is unclear how the offender uses the environment to guide their decision-making processes in selecting their grave sites but Keatley et al highlight the need for investigators to consider the psychological processes of offenders when they investigate crimes as it might aid them in locating clandestine grave sites (9).

### *3.3.4 Grave Site Location*

The mere process of burying a body is to conceal its location which makes its discovery generally difficult to located. However, while the offender might think they have done a great job at concealing the body, they cannot account for the surface changes that are present which can be used by investigators to locate these graves (45-49). In thinking about grave sites, before the grave is dug there are surface characteristics that are present. The topsoil in the location chosen is uniquely layered and will determine the ease in which the grave can be dug.



The presence of leaves, debris, and vegetation are also uniquely laid out and no amount of repackaging the grave will be able to replicate what is on the topsoil (45-49). The soil itself varies depending on the layer reached, where the top layer is generally soft and the bottom layer is more compact. Each layer can also vary in colour, composition, and texture and is unique to the area it's in. Graves are often the size of the body that is being disposed (45-49). Furthermore, considering the lengthy process of digging, this influences the depth of the grave as most individuals dig to a level where it is enough for concealing the body (45-49). As the soil is transposed out of the grave and to the side of it during the digging process, it disrupts the characteristics of the topsoil and becomes incorporated into the mixture outside. When the body is placed into the grave, there is no way to replicate the compactness of the soil that originally was present as well as the features that occurred in the topsoil. Moreover, there is usually excess soil present because of the presence of the body taking up room where it would have been (45-49). As such, graves can often be found because of the discolouration between it and surrounding vegetation. They can also be found due to soil depressions in the middle of the grave site as bodies decay as well as backfill mounds being present. The depressions are associated with overburdens, where soil on the edges of the graves tend to be higher than soil in the immediate vicinity (45-49). The topsoil of the grave will often have different vegetation on it than in the surrounds: as the body decomposition provides added stimulus for growth or in some instances there is a lack of growth. Furthermore, there may be an absence of vegetation due it being incorporated into the fill. The presence of the body can stimulate scavenging activity which alters the appearance of the grave site. Lastly, tenting can occur around trees where soil appears to form a "tent" between the grave and the tree. Tenting does not occur naturally and is a useful predictive tool about where a grave might be located (45-49).

### *3.3.5 Taphonomy*

Taphonomy explains the process in which remains decompose but also offers reasonings for why remains end up in the context in which they are found. Furthermore, taphonomy concerns everything that happens to the organism from time of death to the time of discovery (48). Forensic taphonomy helps investigators and professionals study the processes that affect the preservation of remains which aid in the reconstruction of the events leading to death. Research into this area defines the processes in which the soft tissue changes as well as determining the Post-Mortem Interval. The body found in the burial site can be at any stage of decomposition and therefore it is essential to get a complete picture of the entire process. Christensen et al highlights soft tissue occurs in 3 stages algor mortis, livor mortis, and rigor mortis (49). At the algor mortis stage the body is cooling directly after the death event. The rate of this cooling event is influenced by the difference in temperatures in the environment as well as the body. This stage is marked by the body's chemical reactions beginning to break down (49). At livor mortis the blood pools in the body due to the lack of circulation which causes the reddish-bluish discolouration of the skin. This stage begins from at least 30 minutes post death and completely pronounced at 12 hours (49). Depending on whether blood has coagulated or not will depend on whether livor is fixed or unfixed (49). Rigor mortis is the result of muscle fibres binding together and results in the body becoming fixed in a certain position until the muscle fibres breakdown (49). As with each stage, rigor mortis depends on the environment in which the body is located. Rigor generally sets in about 12 hours after death and subsides within 1 day. After this time, the body goes through significant changes as decomposition sets in and is comprised of autolysis and putrefaction that can occur in tandem or independently (49).

Autolysis is “self-digestion” where the cells are destroyed due to the body’s enzymes. Christensen notes that this stage may be more common in arid environments. Putrefaction is the decay of tissues because of microbial processes within the body which causes distinctive colour changes most notably the marbling effect. In this stage the production of gases causes the bloating of the body which in turn sees the body expanding rapidly (45-49). The presence of clothing or extreme cold climates can cause artifactual preservation where the decomposition process is delayed significantly. Saponification can occur in environments that are unoxxygenated, alkaline, and wet. Saponification causes adipocere to form from fatty tissue (49). Mummification may be encountered in extremely hot and arid climates where the body turns a darkish colour and quite leathery to touch. Skeletisation is the final stage of decomposition where all that is left is the skeletal remains within the grave site, usually occurring within 2-3 weeks. Post-mortem damage to the skeleton can potentially influence the investigation if investigators are not adequately trained in recognising the influences of the environment and the weather (49). Several factors will be discussed in the following section. Bones are discoloured by the soil in which they are placed as well as from the fluids produced during decomposition. In areas of trees and plants the roots can attach to the surface of the bones. Weathering can occur due to the exposure to the elements which results in cracking of the bone, flaking, and roughness (49). Christensen outlines key stages of weathering which are useful in aiding the determination of how long the body might have been exposed to the elements (49). While these are important considerations in taphonomy, of useful interest is the process by which insects interact with the remains. Forensic entomology aids the assessment of the time since death by analysing insect activity on the body and inferring from this time since death. Insect activity occurs relatively instantly, usually within minutes to hours since death.

Blow flies deposit either egg masses or maggots to the body which influences the body's decomposition process (49). Depending on the developmental stages that the larvae go through is a useful determinant of time of death. Insect activity is also incredibly powerful in deducing geographical location of the remains, whether the remains have been moved previously, as well as evidence of possible trauma (49). There is a sequential procession of insect activity to the body, while flies may be the first to arrive once the body is significantly decayed, they leave, and several beetle species are commonly found in the later stages of decomposition (49). After insects, carnivorous mammals are usually next to interact with the remains scavenging whatever they can. This act of scavenging can move the remains to new locations, generally occurring because the joints become disarticulated and are easily picked up by animals to eat. This can influence remain recovery where the remains are often found incomplete (49).

## 4.0 METHODOLOGY

### 4.1 Project Aim

The general aim of this research project is to use Winthroping to identify the geographical features of the environment, along with the decisions-making processes that are taken, that aid in the locating of clandestine burial sites by the experimental methodologies that have been setup for the project studies.

### 4.2 Hypothesis

H<sub>1</sub>: That the use of Winthroping to identify environmental and psychological factors related to clandestine grave selection and body disposal choices by using 100 online participants to select a location on a map of bushland and record their voice data will identify specific geographical landmarks on a map of the environment, as well as specific intrapersonal choices, that determine where a body is dumped.

H<sub>0</sub>: That the use of Winthroping to identify environmental and psychological factors related to clandestine grave selection and body disposal choices by using 100 online participants to select a location on a map of bushland and record their voice data will fail to identify specific geographical landmarks on a map of the environment, as well as specific intrapersonal choices, that determine where a body is dumped.

### 4.3 Project Significance

Winthroping is a novel methodology that could prove to be beneficial in locating clandestine grave sites. This technique would provide investigators an added search method to employ at burial scenes to hasten such efforts. It is hoped that this technique would reduce the reliance on offenders providing details about the whereabouts of their victims and in turn rely on the environmental and psychological factors that influence location choices. This technique would also prove to be beneficial in cold case reviews by giving a new approach to assess old data.

## 5.0 PROJECT DESIGN

The project methodology was approved by the Human Ethics and Research Committee on the 7<sup>th</sup> of September 2021 with the following protocol number: 2021/174 and ID number 694. The study will be conducted in an online format as a survey. Participants will be provided a map of the location area that has been defined by the researchers and asked to choose a location to bury a figurative body. The area on the map is bushland south of Murdoch University near Car Park 7, bounded by Campus Drive, Farrington Road, and Murdoch Drive. They will then be asked to complete an online survey to understand their decision-making processes during the exercise. Participation in the study is reliant on completing the recruitment information letter and consent letter and returning them to the student researcher before completing the exercise. These letters, as well as the recruitment information, survey questionnaire, and promotion material have all been approved by HREC.

## 5.1 Equipment Required

Participants will not need any equipment provided to them to complete their participation. The student researcher will require a functioning computer, hard drive to store participant information and research data, and statistical software including IBM SPSS® Statistical Analysis and ARCGIS®.

## 5.2 Recruitment

As this research is a pilot study, the participants will be recruited via the convenience sampling method. The participant pool will be expected to include a majority of forensic and criminology students; however, the studies are open to any individuals willing to participate. This research exercise is aiming 100 participants for the study. The only exclusionary criteria for the study is any PhD candidates in forensic science or criminology, people under 18, or participants who feel they would be overly affected by the research topic. The recruitment phase will begin with research posters being posted around campus, as well as posts being made on the social media accounts of Murdoch Forensic on Instagram and Facebook. Participants will be advised of the nature of the study, and a brief introduction to the topic being looked at. Participants will be asked to email the student their interest in participating in the research exercises and their preference of which study they would like to participate in. Once feedback has been received, an invitation letter will be sent to the participant's email outlining the specifics of the research studies, the level of involvement required, as well as consent to take part.

### 5.3 Data Collection

Qualtrics XM® will be used to develop the research survey and related questions. Demographics will be collected from the participants in the survey relating to their age, education level, and gender. Further information provided by the participants include their unique identifier to identify their data. Qualtrics will also generate a survey link that will be distributed to the participants and allow them to complete it anonymously. Participants will be asked to use Google Maps® software to generate GPS data relating to the locations they've chosen.

### 5.4 Data Analysis

For both studies similar analyses will be conducted. Hot spot analyses will be conducted from the geographical maps based on the GPS data gained from both experiments. These analyses will look at the pathways chosen by the participants. This will show statistically significant areas of dumpsite locations. Behaviour Tracking based on the paper from Keatley et al will be used to measure similarity between pathways that the participants chose (6). Winthroping Analysis will be used to grade the statements given by participants in both conditions will be transcribed and broken down into waypoints. These waypoints are key areas of the environment that participants use to navigate their location and routes. Similarities will be marked and analysed in terms of psychological concept of affordance and satisficing. Once patterns are found, they will be entered into a matrix forecasting approach to see if predictive pathways can be found.



## **6.0 CONCLUSION**

This research literature review has grounded Winthroping within forensic psychology and environmental by explaining key theories that influence how offender's behaviours are influenced and why they select the clandestine grave sites they do. We now know that offending behaviour is influenced by theories such as Evolutionary Psychology, Affordance, and Satisficing. Furthermore, the use of Environmental Criminology aids our understanding of why offending behaviours occur in specific locations and how Rational Choice Perspective and Routine Activity Theory can aid the explanation of this occurrence. The metrics used to analyse Winthroping, Matrix Forecasting and Behaviour Sequence Analysis, have been shown to be relevant to the method in question and will provide a suitable tool to assess the efficacy and validity of Winthroping.

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## **8.0 APPENDICES**

### **8.1 List of Abbreviations**

BSA- Behaviour Sequence Analysis

DTM: Digital Terrain Model

EC: Environmental Criminology

EP: Evolutionary Psychology

GIS: Geographic Information System

GP: Geographical Profiling

GPR: Ground Penetrating Radar

MF: Matrix Forecasting

RAT: Routine Activity Theory

RCT: Rational Choice Theory

RCP: Rational Choice Perspective





**PART TWO  
MANUSCRIPT**

IDENTIFICATION OF CLANDESTINE GRAVE SITES BY UNDERSTANDING  
LOCATION CHOICES FROM AN ENVIRONMENTAL AND PSYCHOLOGICAL  
PERSPECTIVE.



**MASTERS IN FORENSIC SCIENCE MANUSCRIPT**

IDENTIFICATION OF CLANDESTINE GRAVE SITES BY UNDERSTANDING  
LOCATION CHOICES FROM AN ENVIRONMENTAL AND PSYCHOLOGICAL  
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## **LIST OF ABBREVIATIONS**

BSA- Behaviour Sequence Analysis

DTM: Digital Terrain Model

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GIS: Geographic Information System

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GPR: Ground Penetrating Radar

MF: Matrix Forecasting

RAT: Routine Activity Theory

RCT: Rational Choice Theory

RCP: Rational Choice Perspective

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## **1. ABSTRACT**

Winthroping is a novel forensic search strategy for locating clandestine grave sites. Current use of Winthroping is in counterterrorism efforts, however recent research has highlighted the significance of the strategy in disposal sites. This present study will initially explore the psychological and criminological underpinnings of Winthroping to ground it in theory, and then discuss how it can be incorporated into forensic search strategies. To assess the benefits of Winthroping, an online study of 20 participants was developed to analyse environmental and psychological factors that might influence decision-making regarding clandestine grave location choices. Participants were asked to choose a disposal site in a predetermined outdoor location and asked to provide GPS coordinates of the chosen location. They were then asked 6 questions adapted from Matrix Forecasting research by Keatley et al that formed the follow-up survey to determine these factors. The research revealed that age, gender, and education level were important factors in determining grave site choices. Furthermore, the data revealed satisficing and affordance also influenced disposal locations where participants preferred locations close to vehicle access points, pathways, and bushland in an outdoor location. The study lends support to using Winthroping as a predictive tool for forensic investigators in locating clandestine graves.

### **KEY WORDS:**

Winthroping, Clandestine Graves, Body Disposal Locations, Matrix Forecasting, Routine Activity Theory, Rational Choice Theory, Affordance, Satisficing.

## 2. INTRODUCTION

Why do serial killers choose to dispose of their victims? At first blush this seems like an easy question to answer, but the devil is in the details. Some killers, either first time or serial, choose to dispose of their victims. The reasonings behind this, however, are intricate and complex, but point toward two common themes: preventing/delaying discovery of the victim and maximising the place and time between them and the victim. Some victims are either dumped or concealed depending on the motives and behaviours, where dumping shows no concern to be caught and concealing reflects the broad desire to not be caught. These themes suggest a level of forensic awareness in the offender who attempt to manipulate the process of apprehension by law enforcement by taking these extreme steps. Concealing the victims in clandestine graves delays the discovery, destroys physical evidence present, and to place doubt on the contact between the offender and victim by way of time and location. There is an extreme cost-benefit trade-off that occurs in the offender's decision-making process whereby the risk of getting caught performing the disposal is outweighed by the benefits of this method being successful.

The potential payoff of this method is highlighted in an FBI study that showed that while most victims were found within one day, in 29.6% of cases it took up to fifteen days to recover the body and in 12.1% of cases it took greater than fifteen days (1). Policing agencies are adept at discovering these victims in most circumstances with the development of criminological and psychological theories in Environmental Criminology which forms the basis of Geographical Profiling, as well as forensic strategies to employ at the crime scene which relate to methods in Forensic Archaeology and Crime Scene Management.



These methods are hindered by the uncooperativeness of the offender if caught, who can attempt to conceal information about disposal locations and the whereabouts of their victims for personal gain. Locating the victim without this information can reduce the efficacy and efficiency of forensic methods and policing resources in locating these bodies. FBI research into murder sites showed that 25.8% of murders were committed in outdoor public areas as well as 13.5% in unidentifiable locations (1). Furthermore, outdoor public areas accounted for 61.5% of all disposal sites (1). Crime research conducted from the Australian Institute of Criminology on serial murders between 1989 and 2006 highlighted that in several serial killing's offenders chose outdoor locations to attack and dispose of their victims (2). The physical effort to search and comb large swathes of land intricately to find clandestine burial sites is almost impossible and narrowing down the search area is key (2). Statistics has shown that in 5.6% of cases victims' bodies were never found and dismemberment likely was the cause for this (2). Dismemberment is a counter-forensic strategy used by some killers to increase the likelihood that victims won't be found. Dismemberment was seen in 2.6% of murders and resulted in only partial finds (1,2). This strategy also stymies recovery efforts further, and some jurisdictions do not prosecute "no body" homicides. Winthroping has the potential address this gap by effectively narrowing down the search locations used by policing agencies (3,4).

Winthroping is an under researched technique with little known about it outside of its use as a counterterrorism method employed by the Policing Service of Northern Ireland (PSNI) and the British Army (3,4). This strategy is used to locate clandestine weapons caches that were hidden by the IRA in the 1960's to 1990's. The major tenet of Winthroping relies on the assumption that the selection of these clandestine sites is not random (3,4). It is thought that this is due to the use of environmental landmarks to aid in the memory recall of the location by the individual. Keatley et al suggest that Winthroping can be used in locating clandestine graves because grave site choice is important to the offender (3). Schlesinger et al further highlight that returning to the scene of the crime is a component of some violent crimes to help the offender relive their fantasy (5). We build on the information presented by Keatley et al (3) about Winthroping and further explore it's relevance as a forensic search strategy by demonstrating its background in forensic psychology and environmental criminology as reasons for how it can work.

## **2.1 Forensic Psychology Theories**

### *2.1.1 Evolutionary Psychology*

Evolutionary Psychology (EP) uses an evolutionary biology lens to describe how evolution shaped human cognition and psychology which ultimately have helped human reproduction and survival (6). EP considers that our cognition and psychology are not exempt from the evolutionary pressures humans have faced and have developed just as our biology has (6). Ziegler-Hill posit that our psychology developed to fit an adaptive niche.

EP suggests that there is a relation between the environment and our behaviour where our ancestors would have used specific psychological traits to increase reproductive success and access a larger amount of resources (6,7,). This is highlighted in EP explanations for the presence of emotion, human consciousness, and altruism (8,9,10). Behaviour is a key component to crime, often filling the motives and desires of the offender, and this is the bridge to connect EP to criminal behaviour (6,7). Crime is correlated with age, sex, and socioeconomic status and Durrant notes that it is important to consider the phenomena not just describe its presence (11). This may be why theories past have struggled to explain why criminal behaviour is ever-present. Furthermore, men are more likely to commit violent crime, and display dominance and risk-taking behaviours (11). Criminal behaviour in our ancestors might have afforded an increase in reproductive success as it increases access to necessary resources for survival (11). EP has controversial theories on homicide where Daly and Wilson suggested homicide first came about because it is a powerful strategy dramatically increased evolutionary fitness benefits but comes with extreme risks (12). EP is useful in understanding why offenders commit their crimes in the first instance (6,7,12).

### *2.1.2 Affordance*

While the environment we live in has shaped our biology and psychology, humans also use the environment in unique ways (13). Affordance is the interaction between the environment and the individual which influences behaviour (13). In 1979, Gibson initially saw this as anything that the environment offered the animal and the multitude of possibilities that can occur between the two (13). Gibson's definition is broad and vague but highlights the use of an object and the individual's desires to use the object.

Rietveld and Kiverstein narrowed the definition of affordance and argued that it's critical to note that the key is how the individual perceives the environment (14). Furthermore, affordance exists even if it is not perceived, but relies on the individual's perceptions in how they utilise them. A chair's uses exist even though an infant may not know how to use it (14). Withanage importantly showed that affordances can incite behaviours from an individual because of the relationship that exists (15). This relationship is based on the environment and the individual sending and reflecting behaviours back and forth (15). Heras-Escribano and Pinedo-Garcia interestingly revealed that affordance arose from environmental niches and adaptations (16). Keatley et al provided a link between affordance and criminal behaviour stating that offender's behaviours might reflect the affordances in the environment that therefore leads to specific criminal actions and decision making (3). Offenders may be more attuned to the specificities in the environment and use it in a way to meet their specific goals. The offender has a skill set that in turn reveals affordances that help those behaviours exist. This has potential to be reflected in offenders choosing one location over another to commit their crime (i.e., dimly lit, away from public eye) or also manifesting in the choices that are made to dispose of a body at a particular site. Such factors in choosing a site could be proximity to access point and preferential selection of rural areas over urban areas to disposing of the bodies.

### *2.1.3 Satisficing*

Satisficing is a decision-making heuristic developed by Simon in 1956 which essentially means finding the balance between optimal solutions and satisfactory solutions (13,17). Decision-making does not produce optimal solutions 100% of the time and our choices are influenced and limited by numerous limitations (13,17).

The satisficing approach attempts to resolve these limitations by choosing the “good enough” option, the one that meets the most criteria but not all. Research suggests that satisficing reduces cognitive analysis as well as the time and effort dedicated (13,17). Moreover, Saltsman et al showed that there is a dichotomy of maximisers and satisficers and that satisficers were more likely to feel satisfied with their decisions (18). The authors also suggested that when faced with uncertain information and choice overload, satisficing is the preferred strategy to reach a conclusion (18). Luan & Li highlighted that satisficing is dependent on whether individuals prioritise desirability and feasibility as factors in decision-making (19). Satisficing is linked to the feasibility of an outcome and tends to benefit only the user (19). Interestingly, Dando and Ormerod showed that using satisficing lead to biases like confirmation bias (20). We can link satisficing to criminal behaviour by stating that the uncertainty in committing the criminal act requires a split-second choice to be made which stops them from achieving certain plans. Satisficing might reveal itself in the location bodies are disposed and the picking of such a site. These locations would provide the most gain with the least amount of effort and would explain the common forensic assumption that bodies tend to be disposed of downhill and near vehicular access. Because of satisficing offenders may generally choose options that provide the most gain and the least amount of effort, which might explain why bodies tend to be disposed near vehicular access points and downhill instead of uphill.

## **2.2 Environmental Criminology Theories**

### *2.2.1 Rational Choice Theory*

Rational Choice Theory (RCT) was borne out of a need to explain the non-randomness of crime rates in the early 1970's, where this was due to Cornish and Clarke's concern with more effective crime prevention strategies (13,17,21). Cornish and Clarke capitalised on a gap in the literature that effectively explains the rehabilitation rates and further extended their situational crime prevention theories (13,17,21). RCT's primary tenets suggest that the environment influences behaviour and which determines where crime occurs. Cornish and Clarke see crime as dependent on the offender's background and which meets their motives (21,22). Furthermore, Cornish and Clarke postulated that crime isn't an emotionless occurrence (13,17,21,22). The emotional determinants of crime are such that the offender will choose to commit a crime because of the perceived emotional benefits. Cornish and Clarke suggested that crime should be understood for the perspective of the offender to appreciate their motives (13,17,21,22). Beauregard et al used this approach and developed a framework to understand sexual offender's behaviours (23). Beauregard et al showed that from the offender's perspective they commit their crimes based on the victim's perceived vulnerability and the ease of finding a target (23). Lundrigan and Canter showed that serial murderers selecting disposal sites are heavily impacted by spatial and decision-making processes (24). Moreover, because offenders are driven by their unique emotions and motives, this reflects how they pick their disposal sites (24).

Lundrigan and Canter reiterate that there is a cost-benefit trade off that occurs within the individual's decision-making process whereby they weigh up the emotional satisfaction of selecting a site and the distance required to travel to the site (24). This trade off reveals itself in the analysis of disposal sites of serial murderers, where they showed that offenders operate within their home base as well as the size of this base is unique to each offender (24).

### *2.2.2 Routine Activity Theory*

Routine Activity Theory (RAT) was devised to explain fluctuations of crime rates in the United States between 1947 and 1974 (22,25). Cohen and Felson proposed that there were changes in criminal opportunity that accounted for these crime trends in contrast to thinking at the time which attributed crime to people wanting to break the law (22,25,26). At its core RAT is concerned with the environmental context of crime and the influences this has on behaviour (22,25,26). The offender's routine activities influence crime rates because of the interaction of three key elements of RAT; a motivated offender, a suitable target, and absence of capable guardians (13,17,22,25,26). According to Cohen and Felson crime occurs when all three of these elements exist but oppositely crime can be prevented by removing any one of these elements (25). Activities create criminal opportunities because the target and offender increase the frequency with which they interact with each other (25). Data showed that in relation to non-violent crime offenders live within a geographical area close to their crime (26). Furthermore, homicides converged where both the victim and offender carried out their activities (26).

Spano and Frielich critically examined the core elements of RAT and determined that the presence of a guardian was 5 times more likely to prevent crime from occurring (27). Moreover, target attractiveness (3.3 times), lack of a guardian (5.4 times), and exposure to offenders (3.12 times) increased the likelihood of crime occurring (27). Early research casted doubt on whether RAT was applicable outside of the United States, as Spano and Frielich highlighted (27), however Vilalta and Fondevila introduced RAT within a Mexican context. Vilalta and Fondevila used RAT to assess burglaries in Mexican cities and found that exposure to motivated offenders was the strongest predictor of this type of crime (28). Lundrigan and Canter synthesise the reasons for offenders living and offending in the same area by stating that there is a familiarity and experience with the area they live (24). This allows the offender to navigate the area with relative ease and mitigate any conflicts that might arise.

### *2.2.3 Comparing Rational Choice Theory and Routine Activity Theory*

Regarding body disposal location choices RCT and RAT differ in their assumptions. Lundrigan and Canter highlight such differences when comparing the two theories. RCT is related to the rational choices of the offender and the cost-benefit analysis of reward and risk. RAT visages crime as opportunities that occur within the offender's awareness space and geographical location. Lundrigan and Canter hypothesise that a RCT offender would use an area away from the residential location whereas an RAT offender would dispose of victims within their geographical area and use routes familiar to them. Table 2.2.3 constructed below contrasts important distinctions between the theories based on the literature on RAT and RCT with reference to how offenders might choose their burial sites.



COMPARISON BETWEEN ROUTINE ACTIVITY THEORY AND RATIONAL CHOICE THEORY IN RELATION TO BODY DISPOSAL		
VARIABLE	Rational Choice Theory	Routine Activity Theory
DISTANCE FROM HOME	More likely to travel greater distances	Within geographical area
DISPOSAL SITES	Larger variations of sites chosen	Distinct pattern of sites
COMFORT LEVEL	More likely to be unfamiliar with the area	More likely to be familiar with the area
MOVEMENT OF OFFENDER	Moving between locations to avoid detection	Offender will more likely remain in their geographical area
TYPE OF LOCATION CHOSEN	More likely rural	More likely residential
CANTER AND LARKIN (1993) OFFENDER TYPE	Commuter	Marauder

Table 2.2.3: comparison of RAT and RCT in relation to offenders choosing burial sites.

#### 2.2.4 Geographical Profiling

Geographical Profiling (GP) is the investigative technique that attempts to determine the location of an offender in relation to crimes that they have committed. Canter and Gregory originally proposed that an offender's crimes are influenced by their behaviour and therefore such behaviour would relate to the areas in which they live (29). GP is based on several criminological theories, mostly comprising understandings from RAT and RCP as well as Crime Pattern Theory (29). Brantingham and Brantingham developed the notion that criminals are intrinsically familiar with the area in which they offend (30). In doing so Brantingham and Brantingham developed an action space in which the offender operates based upon their recreational and occupational experiences and related it to pathways and nodes within this network (30).

Canter and Larkin built on this by suggesting that the home has an increased psychological importance (29), and Downs and Stea proposed that offenders make mental maps of the areas they operate in (31). Lundrigan and Canter succinctly describe that the combination of these concepts influences the offender's decision-making process in relation to serial murders and patterns can be drawn from this (24). Rossmo and Rombouts suggest that the benefit of Geographical Profiling is such that it takes large amounts of qualitative and quantitative data and provides a geographical area in which to focus efforts to apprehend the offender (32). A spatial picture is developed based on the interaction of the offender and the victim as well as the linkage of crimes and patterns to provide a geographical picture of where the offender lives (32).

## **2.3 Forensic Processes**

### *2.3.1 Grave Site Characteristics*

Locating these grave sites is a complex task which requires multiple personnel to do so, and Hunter et al mention that no two searches are alike. Investigators incorporate methods from standard crime scene work as well as forensic archaeology to locate these clandestine burial sites (33,34). Clandestine grave sites are defined as a site that has the intention of concealing human remains. (33,34). Investigators can use clues in the environment that reveal the location of these sites as graves have specific features that make them detectable (35,36). Christensen et al note that locating these grave sites is dependent on how well the grave has been dug (37). Moreover, depending on the time the body has been in the grave erosion and scavenging by fauna may reveal the sites (37).

For grave sites that are well buried Cox et al indicate that features such as tenting, absence of debris or staging of debris, and soil inconsistencies are all indicators of a potential clandestine site (33). Tenting is a unique feature of grave sites especially when located near trees, where soil rises against the trunk from the base due to soil being shifted from the grave site (33). According to Cox et al soil inconsistencies manifest themselves through depressions, discolourations, and backfill mounds (excess soil) (33). Additionally, Hunter et al describe the presence of overburdens within the immediate vicinity of the area as further indicators (35). Depending on the length of time the body has been buried is reflected in the decomposition of the body (35). Decomposition of the body involves the breaking down of tissue, fat, and muscle through chemical changes (35). This chemical activity may stimulate or prevent the growth of vegetation within the grave site. Furthermore, Christensen et al and Blau and Ubelaker concur that the presence of insect activity can speed up the decomposition process and in turn cause fauna to travel into the area (34,37).

### 2.3.2 Search Strategies

Search strategies are in part reliant on the foundational understanding of environmental criminology and forensic psychology theories. These theories have emphasised why crime and criminal behaviour is more likely to occur in some areas compared to others as well as how these areas influence criminal behaviour (35,36,37). Therefore, in the investigative efforts are narrowed down to an area of interest, and in relation to clandestine grave sites, a location where a body might be located (35,36,37). Physically searching every inch of area is impossible especially when burial sites as according to Hunter et al and Dupras et al are usually in outdoor areas concealed from plain site (36).

Hunter et al stressed that search strategies rely on the characteristics of the grave site to aid in their discovery (35). Search strategies initially begin with line searches where in either line, spiral, and/or grid shapes (36). The benefits of these searches are that they cover the maximum amount of area (37). Other techniques can be employed such as 3D Ground Penetrating Radar (GPR) (38), geomorphology (39), and geophysical scanning (40). Winthroping can be utilised as a search strategy because human behaviour in part follows the least effort principle. Moses considers Winthroping a potentially effective tool due to this fact in terms of grave site locations that are not usually in areas densely covered by rock, tough topsoil, and away from the vicinity of access points.

## 2.4 Bridging Theories

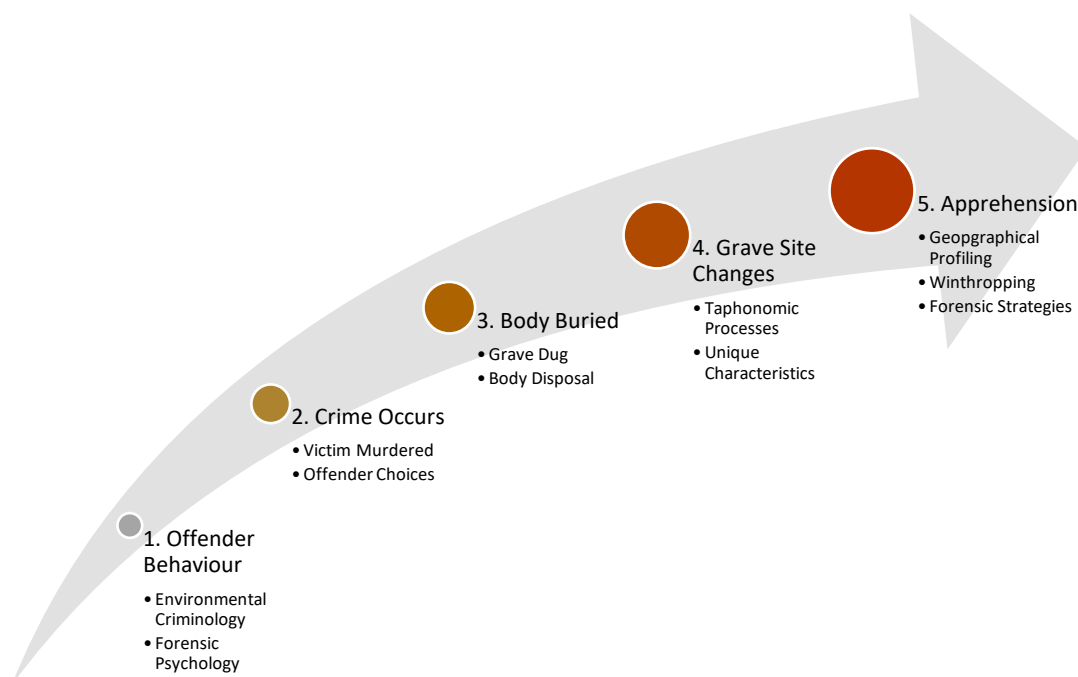


Figure 2.4: summary of events over time that lead to offender committing a crime, disposing of a body, and ultimately getting caught. Time is represented by the arrow and is not to scale.

Figure 1 represents the synthesis of all relevant information how an offender goes from committing a crime through to how they are caught. At step 1 the offender's behaviour is influenced by theories introduced earlier in Environmental Criminology and Forensic Psychology to allow us to understand why crime occurs, victim selection, and decision to commit a crime. Step 2 reflects the crime occurring where the victim is murdered. The offender is still influenced by FP and EC which determines where the victim is going to be disposed and what grave site is chosen and its location. Reaching the 3<sup>rd</sup> step the body has been buried, either partially or completely and the offender leaves this scene. This area is embedded in memory recall. Unique characteristics are introduced at the grave site at Step 4 relating to how the offender has dug the grave. Here soil depressions, tenting, and overburden are all expected to be found. Taphonomic processes influence body decomposition which will effect grave site appearance. To catch the offender and to locate the grave site, at Step 5, relies on all this information at each step and incorporates this into forensic strategies. Winthroping has the potential to identify geographical features of the environment relating to clandestine grave sites by incorporating understandings about offender's decision-making process to locate such sites without the need to rely on information directly from the offender.

The aims of this study were to investigate the potential use of Winthroping to provide a more directed search method for law enforcement agencies to use in clandestine burial cases. This research will aid investigators by positively influencing cases where offenders choose not to reveal the locations of their victims.

The purpose of this research was to develop an understanding of using Winthroping as a forensic search strategy in clandestine burial scenarios. Specifically, this research study aimed at identifying specific environmental and psychological factors that influence clandestine burial site locations and the decision-making processes behind them.

### **3. MATERIALS AND METHODS**

#### **3.1 Sample**

To test this an online survey was created based upon the Matrix Forecasting research developed by Keatley et al. Participation in this study was anonymous and participants were only identifiable by unique codes they had chosen. The study was open to individuals aged 18 and over and excluded individuals who were currently or previously studied a PhD in Forensic Science, Criminology, or Psychology. Demographics of the participants were collected regarding age, gender, and education history. Participants were asked a series of Matrix Forecasting related questions regarding locations they would choose to bury and conceal a body in a pre-determined location near Murdoch University, Western Australia. Figure 3.1 highlights the area in question. Participants were asked to provide GPS coordinates of the site chosen and complete follow up questions to elucidate decision-making factors. The final survey sample size was n=20.

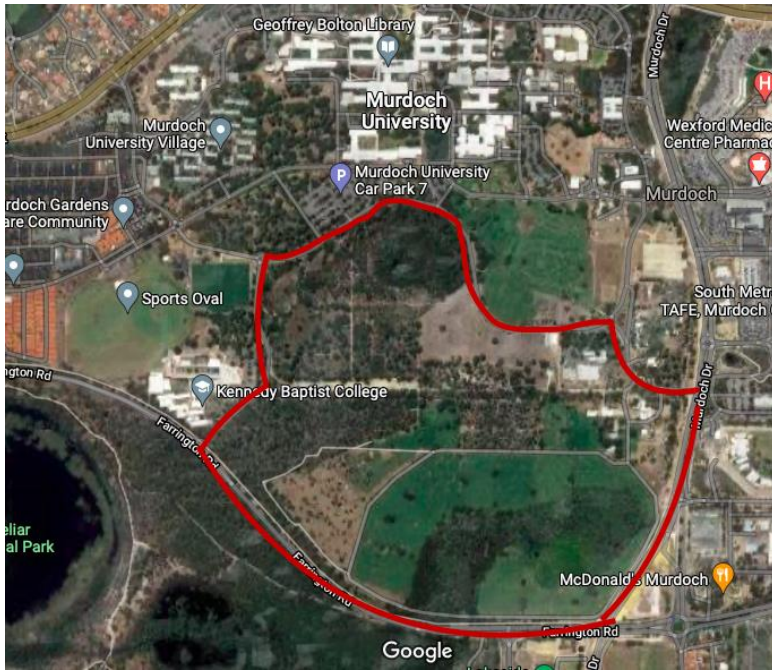


Figure 3.1: Map of the predetermined area used by the research study for the participants.

### 3.2 Survey Design

The survey was designed based on the previous development of Behavioural Sequence analysis and Matrix Forecasting methodologies by Keatley et al (41). These allow for understanding complex behaviours and decision-making processes and theorised by Keatley et al (41) as the method to reveal how Winthroping works. Participants were asked six Matrix Forecasting related questions to allow to analyse specific trends that emerge. Questions related to themes about what locations were chosen and the reasonings, any other alternative routes considered during the process, and how likely participants felt that the location was the best choice. Table 3.2.1 lists the matrix questions from Keatley et al (41) and table 3.2.2 lists the survey questions in detail. Participants were asked to choose a location to bury a figurative body in a predetermined area south of Murdoch University defined in figure 3.2.

<b>MATRIX FORECASTING FOR WINTHROPPING</b>	
<b>1. PREDICTION</b>	A prediction of what is likely.
<b>2. RATIONALE</b>	Drawing on anecdotal, experimental, and practical reasons. Why did you make the prediction?
<b>3. DEGREE OF CERTAINTY</b>	An estimate of how certain you feel about the prediction made in 1.
<b>4. NUMBER OF OTHER ROUTES</b>	A list of possible other alternative location sites or routes.
<b>5. DISCREPANCY</b>	What type of discrepancy occurs?
<b>6. CHANGES NEEDED</b>	What changes are needed to improve the forecasting?
<b>7. LIST OF PRINCIPLES</b>	Summary of principles learned through the process.

Table 3.2.1: Matrix Forecasting methodology developed by Keatley et al and adapted for use as the basis of the questionnaire in the survey.



SURVEY QUESTIONNAIRE	
<b>QUESTION 1</b>	What location was chosen and why? What characteristics did this location have?
<b>QUESTION 2</b>	What route did you end up choosing and why? What characteristics did this route have?
<b>QUESTION 3</b>	Did you initially consider an alternative route? If so what factors influenced you not choosing this option?
<b>QUESTION 4</b>	On a scale of 1-10 how likely do you consider that you chose the best location?
<b>QUESTION 5</b>	What are the reasonings behind the level of confidence?
<b>QUESTION 6</b>	What changes if any would you make to your search strategy?

Table 3.2.2 Survey questions used for the research study

### 3.3 Statistical Analysis

Averages, means, and medians were carried out using Microsoft® Excel (2021) software. The survey was designed using Qualtrics XM OS® (2021) software to collect data relating to demographics, and thematic trends on the matrix forecasting questions. Thematic analysis was conducted on the data by the researchers to analyse the locations and routes chosen by participants to identify predictive pathways. GPS coordinates were collated from the responses by asking participants to utilise Google Maps® (2021) and access specific location data. IBM SPSS® version 28.0.1.0 (142) was used to statistically analyse survey data and identify relationships between variables. ArcGIS® version 10.8.1 was used to develop hotspot analyses.

## 4.0 RESULTS

### 4.1 Survey Demographics

Twenty participants ranged from ages 19 to 52 with the average age of the participants at 25.8 years old. Men and women were almost equally represented in the survey with 10 male participants, 9 female, participants, and 1 participant who identifies as other. 90% of participants are, or have previously studied, an undergraduate or postgraduate degree (n=18). Of these participants, 15% are currently studying an undergraduate degree in forensic science, criminology, or psychology (n=3), and 10% of participants are currently studying a postgraduate degree in either forensic science, criminology, and psychology (n=2). 30% of participants were currently studying an undergraduate degree outside of forensics/criminology (n=6) and a further 30% of participants had completed a degree outside of forensics/criminology (n=6). Only 1 participant had completed a postgraduate degree, this in forensic science or criminology.

### 4.2 Location Choices

ArcGIS analysis revealed 5 cluster points of the location data provided by the 20 participants during the survey. Due to the small sample size, ArcGIS could not provide statistical significance for the locations. ArcGIS recommends data points that are >30 to determine statistical significance. Figure 4.2 highlights the 5 basic clusters provided by ArcGIS.



Figure 4.2: Participant GPS coordinates were collated by ArcGIS® into 5 clusters as shown above to highlight areas of interest within the research study.

Cluster 1 represented 2 participants who chose a location in the immediate vicinity of a road. The average distance to the road was 57.5m, with both data points separated by 72m from each other. In their survey response, both participants selected the site because of the proximity to the road and because of the relative ease of locating the site. Cluster 2 represented 4 participants who chose their locations further in the bushland which features predominantly dense scrub with some pathways through it. In this cluster the average distance to the road was 141.2m. The survey responses of participants in this cluster identified that they considered measures to take to avoid detection and provide coverage to carry out their activities. Participants also determined that they wanted to choose a location as far away from the road as possible. Cluster 3 involved 6 participants who chose their locations in dense bushland but in the vicinity of pathways. Average distance to the road was calculated to include distance from data point to pathway and then to the nearest road which averaged 243.5m. Participants in this cluster chose to use visible pathways to direct them to their disposal location. Participants also indicated that the area was dense to avoid detection but the vicinity to the pathways would facilitate moving of a body.

Cluster 4 involved 6 participants who chose their locations that were near pathways, open areas, and close in proximity to commercial buildings. Areas chosen were less dense regarding bushland. All 6 participants in this cluster were within the immediate area of the pathways, and within 100m of the main entry pathway. Participants in this area determined that their choice of location was influenced by the proximity to trees to provide shelter from being caught, as well as the potential ease of being able to use pathways in the immediate area. Cluster 5 represented 2 participants who chose their locations with an average of 284.4m from the nearest road. This area in question is a dense patch of bushland surrounded in a large grassy paddock. Participants chose locations in this area due to the nearby road providing access and trees for coverage and protection. Participants in the survey were asked to gauge their satisfaction on selecting their location and to provide information on why they picked the number. 55% of participants (n=11) did not select an alternate location and route when prompted to consider a second choice. 45% of participants (n=9) did consider an alternative location and 6 of these participants considered choosing a location closer to nearby roads. On average the 20 participants rated their location choices a 6/10 for satisfaction. A common theme for this was that participants determined that disposal of a body in this location might not be appropriate as well as confidence in carrying out a body disposal.

### 4.3 Variables

Chi-Square analysis, including Fisher’s Exact Test (FET), was performed on the variables age, education, and gender in relation to the location site chosen by the participants. All three variables were correlated with location site in a statistically significant way. Education was the strongest correlator with a P value of 0.181 and a likelihood ratio of 0.252. Next, gender had a P value of 0.243 and a likelihood ratio of 0.343. Finally, age had a P value of 0.426 and a likelihood ratio 0.736. Results of the Chi-Square suggest that location choices are influenced by participants ages, education level, and gender. No relationships were tested comparing men and women to location choices that were made. Nearest Neighbour Analysis (KNN) and Proximity measures tests could not be performed due to low sample size. Table 4.3 lists Chi-Square results.

**CHI-SQUARE TESTS**

<b>VARIABLE</b>	<b>Chi-Square (AS 2-sided)</b>	<b>Likelihood Ratio (AS 2-sided)</b>	<b>Linear-by-Linear (AS 2-sided)</b>
<b>AGE</b>	0.426	0.736	0.616
<b>EDUCATION</b>	0.181	0.252	0.429
<b>GENDER</b>	0.243	0.343	0.425

Table 4.3: Chi-Square Tests of variables in the Winthroping Study.

## 5.0 DISCUSSION

The online study asked participants to select a figurative body disposal location within an area of bushland south of the Murdoch University Perth campus was influenced by the previous research covered in the sections previously as well as the following research and assumptions. Synott et al found that offenders choose body disposal locations in areas where they have lived experienced, as well as knowledge of the area. Furthermore, offenders tend to make conscious decisions relating to disposal locations in comparison to victim selection. Snook et al further reported that serial murderers tend to dispose of locations in greater distance from their home. Research from the FBI analysing the pathways to serial murders found that most serial murderers chose outdoor locations and locations they were familiar with when disposing of their victims (1). An online study was selected for the convenience of the participants as well as to increase accessibility. Moreover, digital aspects of crime are increasing, and it is not unreasonable to suggest that offenders might use mapping services like Google Maps to research the area prior to committing their crimes. Keatley et al showed that in relation to stalking cases, offenders utilised a digital component in victim selection and for committing their offences (42). Based on this the bushland location was chosen as a representative location that offenders might choose to dispose of a body as well as incorporating a methodology that allowed participants to research their desired locations. The survey was designed to prompt participants to consider their location choices and to provide reasons for choosing these locations based on the Matrix Forecasting criteria set out by Keatley et al (3,41).

Matrix Forecasting provides a comprehensive and descriptive approach to understanding the rationale behind decisions that are made, especially by investigators in criminal investigations (41). Keatley et al theorised that Matrix Forecasting (MF) could provide a foundation for assessing Winthroping based on the predictions that can be made in analysing evidence (41). In relation to the current study, the MF steps were adapted to provide a foundation to assess the rationale behind participant choices. From these questions several themes emerged from the responses. Overall, 100% of participants chose a location in bushland even though open areas of land were present in the area. In cluster 2 the respondents made a conscious decision in the survey to select areas away from roads, as well as an area that provided a high level of detection avoidance. While participants preferred these factors, based on the distance to road measurements taken, they averaged to 141.2m. This suggests the participants preferentially prioritised these forensic awareness strategies over physical considerations. This is reflected in the fact that transporting and burying a body 141m from the road would require an immense effort as well as a significant portion of time. The lack of consideration of physical constraints was a persistent theme throughout the survey data, especially in Cluster 3 that returned a distance to road average of 243.5m. This is a potential by-product of the online survey and might be mitigated by performing these tasks in a real world scenario. Participants in this cluster however made a conscious decision to utilise the pathways in the area and the locations were within 100m of a pathway to potentially mitigate these physical constraints. 90% of participants have completed or are currently undertaking either an undergraduate or postgraduate degree. The large representation of educated participants might explain the level of forensic awareness and detection avoidance strategies revealed in the survey responses.

FBI serial murderer pathway research indicated that murderers who chose to transport a body after the murder, more than half had an education level greater than the high school level (1). Participants who have a higher education background may critically assess the components of a potential dumpsite and determine its potential uses. This is reflected in Affordance theory which suggests that the environment reveals uses to individuals depending on their needs (14,15), and offenders with a higher education background might use the environment in specific ways that differ from individuals with no higher education background. Satisficing is expressed in the preference of forensic strategies compared to physical constraints. The theory predicts that decision-making is influenced by picking the most satisfying option available (17,18,26). The dichotomy of forensic strategies and the physical implications means that locations are chosen that satisfy both considerations; while participants chose areas to avoid being caught, they also picked an area that they could transport a body. Satisficing is also revealed when participants were asked if they considered other locations than the one chosen. More than half of the participants did not select a second site or route when asked, which indicates a level of satisficing in their choices. The survey responses indicated that education level and location site choice was statistically significant. Other statistically significant variables included age and gender. As previously discussed, age, gender, and education level are all correlated with crime and are determinants of crime. It is no surprise to see that these variables are important when factoring how an offender might choose a disposal site. Age relates to experience, and while survey data was not able to determine the differences in ages and disposal sites, it may play an important role.



Further studies might aid in determining whether the level of education influences individuals to choose better locations. Further research studies might benefit from recruiting participants from differing educational backgrounds to determine what differences, if any, exist. However, the results of this study seem to support the notion that smarter individuals would pick better locations as most participants tried to incorporate some level of forensic strategy in their location choice.

Young offenders with less experience may choose a disposal location that might increase being apprehended compared to older offenders who are more experienced and are able to successfully incorporate forensic strategies. Winthroping would potentially exploit the themes gained from the data and incorporate it in search strategies. Within the Matrix Forecasting, investigators can predict disposal locations by factoring in the predictions that body's might be disposed of in locations near pathways within bushland, and in the vicinity of access roads. When disposed outside, bodies would more likely be in secluded areas compared to open areas. This information can add an extra tool in the investigator's arsenal. It is important not to overstate the results of this study, where the sample size was small which meant that most statistical tests to determine significance could not be performed. The Chi-Square tests however shed light on potential important relationships between the tested variables and location choices. Further studies might see benefit in exploring this study and replicating it in a physical manner. The differences in location choices might be different when participants are asked to physically choose a location rather than selecting a GPS coordinate online.

The relationship between disposal sites and the variables age, gender, and education level should also be explored to determine if these are important factors that influence such choices. The online study asks participants, whose criminal background is unknown, to pick a disposal site. The limitation here is that there might exist variations in site choices in actual homicide offenders compared to individuals who probably have not committed this type of crime previously

## **6.0 CONCLUSION**

Winthroping is a valuable predictive tool that forensic investigators can employ when searching for clandestine grave sites. Understanding the psychological and criminological theories that underpin help guide its use. Furthermore, by introducing Matrix Forecasting methodology clandestine grave locations can start to be predicted. This study included 20 participants and devised a survey that describes their decision-making process which highlight psychological and environmental factors that influence clandestine grave site selection. Based on the results of this study, age, education level, and gender were all important factors in determining grave site choice. Furthermore, trends from the data revealed that locations were close to vehicle access points, pathways, and within bushland. Participants also exhibited levels of detection avoidance and forensic strategies which also influenced their location choices.

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