PROFILING THE PROFILER: EXPLORING THE ROLE OF CUES IN THE DEVELOPMENT OF EXPERTISE WITHIN THE DOMAIN OF OFFENDER PROFILING

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DEDICATION

To my beautiful wife Nat; I wouldn’t be here without you. Thank you for everything.

To my Mum, who never ceases to give.

To my Dad, my best mate who has never let me down.

To Linda, Greg, & Jasmin, who offer us so much happiness.

To Harry & Di, who have supported me like a son.
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STATEMENT OF AUTHENTICATION

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

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Ben William Morrison

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Date this day, 31st of March 2010
# Table of Contents

Title Page i
Dedications ii
Acknowledgements iii
Statement of Authentication iv
Table of Contents v
List of Tables xiii
List of Figures xiv
Abstract xvii

1. Approaches to Decision-Making Theory and Research 28
   1.1 Chapter Overview 30
   1.2 Decision-Making 30
   1.3 Normative Approaches to Decision-Making Theory and Research: How People Should Make Decisions 31
      1.3.1 Limitations of the Normative Approach 33
         1.3.1.1 Time-Pressure 33
         1.3.1.2 Finite Cognitive Resources 34
         1.3.1.3 Incomplete/Imprecise Information 36
   1.4 Descriptive Approaches to Decision-Making Theory and Research: How People Actually Make Decisions 37
      1.4.1 The Representativeness Heuristic 37
      1.4.2 The Availability Heuristic 39
      1.4.3 The Anchoring and Adjustment Heuristic 40
1.5 Integrating Normative and Descriptive Approaches to Decision-Making Theory and Research

1.6 The Naturalistic Decision-Making Paradigm: How to Help People Make Good Decisions in the Real-World

1.7 Chapter Two Brief

2. The Cognitive Components that Moderate Decision Quality across Expertise and the Significance of Cue-Use Differences

2.1 Chapter Overview

2.2 The Cognitive Components that Moderate Decision Quality across Expertise

2.2.1 Cue-Use and Decision Quality across Expertise

2.2.2 Working Memory Limitations and Decision Quality across Expertise

2.2.3 Long-term Memory and Decision Quality across Expertise

2.3 The Significance of Cue-Use Differences across Expertise

2.4 Thesis Aim

2.4.1 Study 1: The Elicitation of Potential Cues and their Associated Concepts

2.4.2 Study 2: Measuring Cue-Based Associative Strength as a means of Discriminating Expert and Novice Cue Activation and Identifying an Inventory of Expert Cues and their Associated Concepts
2.4.3  Study 3: The Impact of Associated Concepts Exposure (ACE) Training on Cue Activation and Decision Performance in a Group of Novice Decision-Makers

2.5  Chapter Three Brief

3.  Offender Profiling as a Context for Examining Cue-Use across Expertise

3.1  Chapter Overview

3.2  Offender Profiling

3.3  Conclusion

3.4  Chapter Four Brief

4.  Study 1: The Elicitation of Potential Profiling Cues and their Associated Concepts from Expert and Novice Profilers

4.1  Study Objective

4.2  Background/Rationale

4.2.1  Critical Decision Method

4.3  Aim

4.4  Method

4.4.1  Participants

4.4.2  Stimuli/Measures

4.4.3  Procedure

4.5  Results

4.5.1  Extraction of Feature Descriptions

4.5.1.1  Inter-Coder Agreement – Content Analysis

4.5.2  Collapsing Feature Descriptions into Concept Labels

4.5.2.1  Inter-Coder Agreement – Thematic Analysis

4.6  Discussion
5. Study 2: Measuring Conceptual Associative Strength as a Means of Distinguishing Cue Activation across Expertise, Validating Qualitative Outcomes, and Identifying an Inventory of Expert Profiling Cue-Based Associations

5.1 Study Objective

5.2 Study 2a: Distinguishing Novice and Expert Cue Activation by Measuring Conceptual Associative Strength across Expertise

5.2.1 Background/Rationale

5.2.1.1 Conceptual Associative Strength

5.2.2 Aim

5.2.3 Method

5.2.3.1 Design

5.2.3.2 Participants

5.2.3.3 Stimuli/Apparatus

5.2.3.4 Procedure

5.2.4 Results

5.2.4.1 Data Reduction

5.2.4.2 Analyses

5.2.5 Discussion

5.2.5.1 Association Agreement

5.2.5.2 Association Response Latency

5.2.5.3 Limitations

5.2.5.4 Conclusion
5.3 Study 2b: Participants’ Perceptions of Cue-Based Associations from the Expert and Novice Target Samples

5.3.1 Background/Rationale

5.3.1.1 Perceived Frequency of Use

5.3.1.2 Perceived Strength

5.3.1.3 Perceived Domain Specificity

5.3.1.4 Perceived Diagnosticity

5.3.1.5 Expertise and Cue Discrimination

5.3.2 Method

5.3.2.1 Design

5.3.2.2 Participants

5.3.2.3 Stimuli/Apparatus

5.3.2.4 Procedure

5.3.3 Results

5.3.3.1 Data Reduction

5.3.3.2 Analyses

5.3.4 Discussion

5.3.4.1 Perceived Frequency of Use

5.3.4.2 Perceived Strength

5.3.4.3 Perceived Domain Specificity

5.3.4.4 Perceived Diagnosticity

5.3.4.5 Expertise and Cue Discrimination

5.3 General Conclusion

5.4 Chapter Six Brief
6. Study 3: The Impact of Associated Concepts Exposure (ACE) Training on Cue Activation and Decision Performance

6.1 Study Objective

6.2 Study 3a: The Effect of ACE training on Naïve Cue Activation

6.2.1 Background/Rationale

6.2.2 Aim/Research Question

6.2.3 Method

6.2.3.1 Design

6.2.3.2 Participants

6.2.3.3 Stimuli/Apparatus

6.2.3.4 Procedure

6.2.4 Results

6.2.4.1 Data Reduction

6.2.4.2 Analyses

6.2.5 Discussion

6.3 Study 3b: The Potential Impact of Improved Cue Activation on Novice Decision Performance

6.3.1 Background/Rationale

6.3.2 Aim/Research Question

6.3.3 Method

6.3.3.1 Design

6.3.3.2 Participants

6.3.3.3 Stimuli/Apparatus

6.3.3.4 Procedure

6.3.4 Results
6.3.4.1 Analyses

6.3.4.1.1 Cue Activation (P-CAT) Performance (Pre- vs. Post-training)

6.3.4.1.2 Decision Performance (Pre- vs. Post-training)

6.3.4.1.2.1 Accuracy

6.3.4.1.2.2 Time

6.3.4.1.2.3 Information Acquisition

6.3.5 Discussion

6.4 General Discussion

6.5 Chapter Seven Brief

7. General Discussion: A Summary of the Thesis Findings, General Conclusions, Limitations, Recommendations for Future Research, and Implications

7.1 Chapter Overview

7.2 Thesis Findings

7.3 General Conclusions

7.4 Limitations and Recommendations for Future Research

7.5 Implications

7.5.1 Knowledge Elicitation Strategies

7.5.2 Cue-Based Training

7.5.3 Offender Profiling

7.5.4 Naturalistic Decision-Making Paradigm

8. References
Appendix A  Four Text-Based Criminal-Act Scenarios: Study 1
Appendix B  The Real-Time CDM Protocol: Study 1
Appendix C  The P-CAT Script for Use in DMDX: Study 2a
Appendix D  The Familiarisation Trial Stimuli: Study 2a
Appendix E  Preliminary Tests for Presentation Durations/Intervals: Study 2a
Appendix F  Complete List of the Expert and Novice Target Samples: Study 2a
Appendix G  A Copy of the Association Perception Survey: Study 2b
Appendix H  The 46 Concept Pairings from the Expert Target Sample: Study 3a
Appendix I  The Revised P-CAT Script for Use in DMDX: Study 3a
Appendix J  The ACE Training Program Script for Use in DMDX: Study 3a
Appendix K  Pen and Paper Paired-Concept Recognition Task: Study 3a
Appendix L  A Complete Animated Demonstration of both an Implicit Scenario and an Explicit Scenario
Appendix M  Complete Versions of Each Scenario (including all scenario descriptions, concept label values, and crime scene graphics)
LIST OF TABLES

Table 4.1 A List of Useful Probing Questions Used in the CDM as Proposed 75 by Klein et al. (1989)

Table 4.2 The Crime-Related Concept Labels, Contributions, and Feature 85 Description Examples

Table 4.3 The Offender-Related Concept Labels, Contributions, and Feature 88 Description Examples

Table 5.1 The Top Five Cue-Based Associations from each Target Sample 107 (Expert and Novice), Based on Agreement and Response Latency

Table 5.2 A Comparison of the Crime-Related Concepts Evident in Each 110 Target Sample. The Number of Occurrences is in Parentheses

Table 5.3 A Comparison of the Offender-Related Concepts Evident in Each 112 Target Sample. The Number of Occurrences is in Parentheses

Table 5.4 The 20 Concept Pairings (10 expert and 10 novice) Used in the 124 Survey

Table 5.5 A Summary of Expert and Novice Perceptions across Expert and 133 Novice Target Samples

Table 6.1 Participants’ Pre- and Post-Training Scores across each Interface 170 Style
LIST OF FIGURES

Figure 2.1 A diagrammatic representation of the proposed stages of research. 63

Figure 3.1 An illustrated example of a possible profiling association used by an FBI profiler. 68

Figure 5.1 An illustration of the P-CAT set-up on a laptop computer. 98

Figure 5.2 An example of the sequence of screen presentations within the P-CAT. 105

Figure 5.3 A concept map of the associations between crime-related concepts and offender-related concepts, as evident in the expert target sample. 108

Figure 5.4 The mean response latency (+SE) for experts and novices for the pairings from the expert target sample. 114

Figure 5.5 The mean perceived frequency of use (+SE) for each target sample across expertise level. 127

Figure 5.6 The mean perceived strength of association (+SE) for each target sample across expertise level. 130

Figure 5.7 The experts’ mean perceived domain specificity (+SE) for each target sample. 131

Figure 5.8 The experts’ mean perceived diagnosticity (+SE) for each target sample. 132

Figure 6.1 An example of the sequence of screen presentations within the revised P-CAT. 147
Figure 6.2  An example of the sequence of screen presentations within the ACE training program.

Figure 6.3  The mean response latencies (+SE) for the expert target sample, for pre- and post-intervention stages, for both the training and no training groups.

Figure 6.4  A diagrammatic flow chart of the experimental design for Study 3b.

Figure 6.5  An example of a crime scene graphic used in the decision assessment interface.

Figure 6.6  A comparison of the implicit and explicit styles of interface as seen in the decision assessment interface.

Figure 6.7  Screen shots of the assessment interface process and the two possible interface styles (implicit and explicit) that participants could receive.

Figure 6.8  Novices’ mean response latency (+SE) for the 46 associations (drawn from the expert target sample), prior to, and following, training. The experts’ response latencies for the same 46 associations (as observed in Study 2a) have been included for comparative purposes.

Figure 6.9  The mean time taken (+ SE) to make a decision in both the pre- and post-training conditions, across each of the two interface styles (implicit and explicit).

Figure 6.10  The mean number of concept labels viewed (+SE), across the two interface styles (implicit and explicit).
Figure 6.11  The mean number of concept labels used (+SE), across the two interface styles (implicit and explicit).  175

Figure 6.12  An illustrated example of the organised/disorganised dichotomy (adapted from Alison et al., 2002).  184

Figure 6.13  A concept map which depicts the degree of shared activation amongst cues (crime-related concepts) from the expert target sample.  186
ABSTRACT

Cues have been identified as important precursors to successful decision-making amongst expert practitioners. Consequently, the use of expert cues in novice training programs is an attractive option for skill development. This thesis adopted the naturalistic approach to decision-making theory and research to investigate potential differences in cue activation (and presumably use) across two stages of expertise (expert and novice). The aim of the research was to determine whether it is possible to improve novice decision-making performance based on a modelling of expert cue activation. The research used the practice of Offender Profiling as a domain for investigating cue-use across expertise and involved three studies. Study 1 employed an interview strategy to identify a number of potential concepts of interest to expert and novice profilers when formulating decisions. Using content and thematic analyses, the findings yielded a number of crime-related and offender-related concept labels to be used as a basis for discriminating between expert and novice cue activation in Study 2. Study 2 incorporated two phases of research, the first of which (Study 2a) presented pairs of the concept labels identified in Study 1 as part of a Paired-Concept Association Task (P-CAT), which recorded participants’ response latency in recognising associations between the concepts. The second phase (Study 2b) involved the distribution of a survey to further test participants’ perceptions of the associations between concepts in relation to their frequency of use, strength, diagnosticity, and domain specificity. The findings of Study 2 revealed that the P-CAT was able to accurately discriminate between expert and novice cue activation and yielded a number of cue-based associations that were recognised/activated consistently and rapidly by, predominantly, the expert profilers. Further, the experts’ perceptions of the associations reflected their response latencies. However, novice perceptions did not differentiate between associations, suggesting that the ability to discriminate between cues is a function of expertise. Finally, Study 3 investigated whether
novice acquisition of the expert-cue-based associations was beneficial to their decision-making performance. Two phases were reported, the first of which (Study 3a) employed an experimental training program, Associated Concepts Exposure (ACE), to aid naïve participants’ acquisition of a number of expert cue-based associations. Study 3b, again, used ACE training; this time with novices. Additionally, this phase was designed to determine whether potential improvements in novices’ recognition of expert associations were matched by concomitant improvements in several facets of decision-making performance, including decision accuracy, time, and information acquisition. Finally, this phase sought to determine whether potential improvements in novice performance were impacted by the extent to which the decision scenarios engaged reflected a naturalistic scenario. Study 3b employed a decision assessment interface which functioned as a surrogate for the operational environment, enabling users to explore, acquire, and integrate cue-based information in quasi-realistic profiling decision tasks. The interface was administered prior to, and following, ACE training. The outcomes of Study 3 revealed that a set of expert cue-based associations could be acquired by both naïve and novice participants using ACE training. Moreover, exposing novice profilers to a set of expert cue-based associations improved their decision-making performance in a profiling decision task. However, the results also revealed that the novices were unable to improve their decision performance within a task consistent with a naturalistic scenario. It was concluded that, although the acquisition of valid cue-based associations is vital to the development of expertise, a cognitive gap remains between expert and novice performance that cue-use alone cannot account for. Ultimately, the key to closing this gap appears to hinge on a number of additional cognitive skills (e.g., the construction of mental models based on the retrieval of decision cases from long-term memory) which many decision-makers will most likely acquire as a result of extensive domain-specific operational experience. The primary limitation associated with each of the three studies detailed was the
predominant use of text-based descriptions to represent cue-based information. Future studies may seek to explore more naturalistic representations. The thesis findings have implications for a number of key areas, including: knowledge elicitation strategies, cue-based training, offender profiling, and the naturalistic decision-making paradigm.
Chapter 1

APPROACHES TO DECISION MAKING
THEORY AND RESEARCH
Sherlock Holmes closed his eyes and placed his elbows upon the arms of his chair, with his finger-tips together. “The ideal reasoner,” he remarked, “would, when he had once been shown a single fact in all its bearings, deduce from it not only all the chain of events which led up to it but also all the results which would follow from it.”

- Sherlock Holmes, in “The Five Orange Pips”
1.1 CHAPTER OVERVIEW

Chapter One will involve an examination of the human decision-making process from several perspectives. Each of these perspectives differs in regard to their approach to decision-making theory and research. The chapter will conclude with the selection of the approach which will guide the current research, and a brief outline of the direction of the thesis.

1.2 DECISION-MAKING

A decision is characterised by three components, including: a judgment, or, choice, between two or more options, resulting in a course of action or commitment, to the exclusion of others; the choice between these multiple options is formulated under conditions of uncertainty; and, this choice involves a degree of risk (Bell, Raiffa, & Tversky, 1988). The process by which a decision is formulated, decision-making, can be described as a subset of an individual’s information processing capacity (Howell & Fleishman, 1982; Lehto & Nah, 2006; Wickens & Flach, 1988; Wickens & Hollands, 2000).

Generally, information processing involves the acquisition of information, the encoding of information, the recall of information from memory, and the integration of this information to establish a mental representation or an internal explanation or model for how something operates within the external world (Wickens & Flach, 1988). According to Wickens and Hollands (2000), information processing is involved at three key stages of the decision-making process.

The first stage of decision-making involves the perception, and selection of cues. Cues, in their simplest sense, can be conceptualised, as indicators of something meaningful in the navigation of an environment or scenario (Wiggins, 2006). In the second stage of processing, the selected cues are evaluated and integrated, allowing the decision-maker to form a diagnosis of a situation and, if necessary, generate a number of potential responses (Garcia-Retamero,
Hoffrage, & Dieckmann, 2007). Finally, in the choice stage, the decision-maker considers the potential outcomes associated with various responses (e.g., their relative degree of risk) and, ultimately, selects a response (Wickens & Hollands, 2000).

This three stage process represents a highly simplistic model of human decision-making and the cognitive systems involved. However, there are numerous approaches to decision-making theory and research, each varying in their philosophy, aims, and methods. The two dominant approaches to decision-making theory and research are referred to as normative and descriptive (Bell et al., 1988), and these are now reviewed.

1.3 NORMATIVE APPROACHES TO DECISION-MAKING THEORY AND RESEARCH: HOW PEOPLE SHOULD MAKE DECISIONS

Normative approaches to decision-making theory and research are based on the expectations and consequences associated with a decision, emphasising the importance of an optimal decision outcome (Clemen, 1996). These theories assert a basis for how people should decide, by providing logically consistent decision procedures that instruct the decision-maker about the ideal process of decision-making (Bell et al., 1988; North, 1968).

Normative decision procedures have been devised, generally by economists, to inform the decision-maker in performing analytical and systematic comparisons between options, while reducing the impact of biases and contextual factors associated with a decision-maker’s natural process of problem-solving (Keller, 1989). These procedures are based on the presumption that a decision-maker should strive to choose the option that will result in the most successful outcome: a process referred to as optimisation (DeGroot, 1970).

Optimising procedures generally require the investigation and weighting of all alternatives and their consequences (Tversky, 1975). This process assumes that a strictly rational
choice is made by the decision-maker, whereby the preference for one option over another is based upon the foreseeable utility of one’s actions (Shoemaker, 1982). A common example of this process is the maximisation of expected utility theory (von Neumann & Morgenstern, 1947), which posits that a decision-maker will choose between options by comparing their expected utility. The utility of an option refers to a measure of the option’s outcome value, that is, the relative benefits gained as a result of its selection over another option (Bleichrodt, Pinto, & Walker, 2001).

Consider the following as an example of the application of expected utility theory. A decision-maker is given a choice between two investment options: option A and option B. Option A involves a 25% return on a $100 investment. Option B involves a 60% return on a $40 investment. According to expected utility theory, the choice of one option over another is the average utility of the outcomes associated with this choice. The decision-maker weights the utility of each outcome by the probability that the outcome results from that choice. In this example, the expected utility of option A is $25. The expected utility of option B is $24. The probability that each outcome is associated with each option is certain (100%). Thus, the decision-maker can determine that, of the options available, option A maximises expected utility (i.e., it is optimal).

Theoretically, normative procedures that seek optimisation can provide a useful formula for many problem-tasks, as demonstrated in the previous example. Further, these strategies have been extended/modified to allow for a wider range of behaviour than those consistent with expected utility theory (e.g., the subjective nature of evaluation (Savage, 1954)); and deliberation with multiple objectives (Goicoechea, Hansen, & Duckstein, 1982). Nevertheless, a significant
problem with these procedures, and the normative approach itself, exists in relation to the
presumption of rationality as optimisation.

As asserted previously, normative approaches to decision-making are based on the
presumption that the decision-making process is perfectly rational, in the sense that the decision-
maker has a logical process of deliberation, which is usually based on an analysis of the expected
outcome (Bell et al., 1988). Although rationality in decision-making is generally a desirable
attribute, it could be argued that normative approaches often require unbounded rationality,
having little, or no regard for three important limitations associated with human, real-world,
decision-making: time-pressures, finite cognitive resources, and, incomplete and/or imprecise
sources of information (Gigerenzer & Goldstein, 1996; Gigerenzer & Todd, 1999; Kahneman,
2003; Simon, 1997). Each of these limitations will now be discussed in turn.

1.3.1 Limitations to the Normative Approach

1.3.1.1 Time-pressure

Decisions are made in real-time, with decision-makers often facing situations in which
they are pressured to formulate a response in a timely manner (Klein, 1998; Klein, Calderwood,
& Clinton-Cirocco, 1986). Further, in many scenarios, the efficiency with which a response is
made is as vital as the appropriateness of the response (Gigerenzer & Goldstein, 1996). Such
time-pressures often have an adverse effect on decision performance (Ariely & Zakay, 2001).

Van Bruggen, Smidts, and Wierenga (1998) demonstrated that decision-makers operating
under low time-pressure tend to outperform those operating under high time-pressure. This may
occur for two reasons; firstly, the time-pressured decision-maker does not have the time
necessary to process all of the information required for a given task (Johnson & Payne, 1985);
and, secondly, both the monitoring of time and the acceleration of the decision process requires
the allocation of limited cognitive resources (Ariely & Zakay, 2001). As a result, the introduction of time-pressure will often impact the decision-making process engaged by an individual.

Ben-Zur and Breznitz (1981) have proposed a hierarchy to explain the decision-maker’s response to time-pressure. The model describes three processes. Firstly, the decision-maker will attempt to accelerate the decision-making process. Secondly, if there is greater time-pressure, the decision maker may focus his or her attention on a smaller section of information, perhaps even engaging a speed/accuracy trade-off (Wickelgren, 1977), whereby he or she will choose to forgo a degree of accuracy in exchange for a more timely response. Finally, if the time-pressure is too great for acceleration and filtration, the individual may simply select a different, and often simpler, strategy.

Ben-Zur and Breznitz’s (1981) model implies that a decision-maker may actively select a decision-making strategy based on the characteristics of a task, and, that, given a situation characterised by high time-pressure, may avoid engaging a time-consuming, analytical strategy, such as those prescribed by normative approaches. For example, Morrison, Wiggins, and Porter (2010) tested the impact of introducing a high-time pressure in simulated decisions involving the forensic analysis of crime-scenes. They noted that, when making decisions under a high time constraint, participants actively sought a strategy that reduced the number of comparisons required between options.

1.3.1.2 Finite cognitive resources

The act of decision-making requires the investment of a decision-maker’s cognitive resources, such as attention and memory (Todd & Benbasat, 1999; Pashler, 1988). According to the theory of Bounded Rationality, humans, as information-processors, are subject to limitations in the distribution of these cognitive resources (Simon, 1997). Consequently, the amount of
information that an individual can process at any given time is also limited (Sweller, 1988). This has been demonstrated by Miller’s (1956) classic research examining the capacity of working memory.

Miller’s (1956) findings revealed that, generally, an individual has the capacity to hold seven, plus or minus two, pieces of information in working memory, although this number may vary as a function of information presentation and expertise (Chandler & Sweller, 1991). Generally, as the amount of information to be held in working memory is increased over a period of time, there is a reduction in the cognitive resources available for the processing of information, resulting in a strain or load on working memory; namely cognitive load (Paas, Tuovinen, Tabbers, & Van Gerven, 2003; Pollock, Chandler, & Sweller, 2002).

Cognitive Load Theory (Sweller, 1988) suggests that optimal performance and learning occurs when cognitive load is minimised. Three types of cognitive load exist (Brunken, Plass, & Leutner, 2003), including; intrinsic cognitive load, which is the degree of strain on processing that is moderated by characteristics of the task itself (Chandler & Sweller, 1991); extraneous cognitive load, which is the degree of strain on processing that is moderated by the method of information delivery (Clark, Nguyen, & Sweller, 2006); and, germane cognitive load, which is the degree of strain on processing that is moderated by a person’s previous degree of experience and skill with a given task (Gerjets & Scheiter, 2003; Renkl & Atkinson, 2003).

Cognitive load appears to perform a moderating role in strategy selection during decision-making (Todd & Benbasat, 1999). This is consistent with an evolutionary perspective, whereby an individual might try to conserve scarce resources and only choose to invest greater resources when engaging a task of greater consequence (Nowell, 1999). As such, when the decision process requires significant effort, a decision-maker compares the costs of the process
against the anticipated improvement in performance (i.e., a cost-benefit analysis) (Johnson & Payne, 1985). Indeed, several studies have demonstrated that a decision-maker, given a choice between strategies, will actively engage a strategy that reduces the cognitive load associated with a task (Morrison et al., 2010; Paquette & Kida, 1988; Payne, Bettman, & Johnson, 1988; Todd & Benbasat, 1999; Wiggins & Bollwerk, 2006). Given that normative procedures generally require the comparison of a potentially exhaustive number of variables across multiple options, it is highly unlikely that decision-makers will naturally seek to engage such strategies, and nor are they realistically capable of doing so in real-world environments.

1.3.1.3 Incomplete and/or imprecise information

Most normative approaches that prescribe optimisation, such as expected utility theory, rely on the weighting of all information and options (von Neumann & Morgenstern, 1947). This assertion implies that the set of options in every decision task is static, and that all of the information associated with each option is complete and known to the decision-maker. However, in the ‘real-world’, decision-making frequently involves uncertainty (Tversky & Kahneman, 1974), and decision-makers will often receive imprecise and/or incomplete pieces of information, making many probability-based calculations difficult, if not impossible.

On the basis of these three limitations (time-pressures, finite cognitive resources, and incomplete and/or imprecise information), it might be argued that normative procedures are neither a true reflection of the human decision-making process, nor are they practical to prescribe, given the limitations associated with real-world decision-making. As a result, much research has recently been directed towards understanding how people actually make decisions in real-world environments by observing and describing their methods.
1.4 **DESCRIPTIVE APPROACHES TO DECISION-MAKING THEORY AND RESEARCH: HOW PEOPLE ACTUALLY MAKE DECISIONS**

Descriptive approaches to decision-making theory and research emphasise the understanding of how people make decisions by *describing* the decision process as it occurs in real-world environments, without intervention or manipulation (Vazsonyi, 1990). Real-world environments involve a varying set of features which compete for a decision-maker’s limited cognitive resources (Bellman & Zadeh, 1970). In these environments, there can be a degree of uncertainty associated with goals, constraints, and/or the consequences associated with a problem-task.

Tversky and Kahneman (1974) have proposed that much human judgement in real-world environments is based on the use of so-called simplifying heuristics. The basis for these heuristics is presumed to exist spontaneously during information processing (Paquette & Kida, 1988), and is said to be consistent with the pre-existing computations and the cognitive architecture of the human mind (Griffin, Kahneman, Aspinwall, & Staudinger, 2003). Although up to seventy different heuristics have been identified (Gilovich, Griffen, & Kahneman, 2002), three heuristics that are observed commonly during the decision-making process are detailed here.

1.4.1 **The Representativeness Heuristic**

The representativeness heuristic is often employed when a decision-maker is asked to assess the probability that an object or event belongs to a group or process (Tversky & Kahneman, 1974; Kahneman & Tversky, 1972). Mervis and Rosch (1981) demonstrated that information is commonly stored and processed in conjunction with the use of a mental model. A mental model is an internal representation of the external world (Markham, 1999; Johnson-Laird,
1983) that specifies the relationship between concepts (Cannon-Bowers, Salas, & Converse, 1993). Thus, it is logical for an individual to assess the probability that an event belongs to a category of events based on its representativeness, or fit with an existing mental model. For example, if an individual is asked the probability that person A is a member of group B, he or she might make this judgement contingent on the degree to which person A resembles group B. Where person A is perceived as highly representative of group B, the probability that person A is from group B is assessed as relatively high.

The representative heuristic can be relatively effective during decision-making because it allows the decision-maker to rely on a limited number of salient cues, reducing the decision-maker’s need to search for, and integrate, large amounts of information. For example, when searching for a police officer in a crowd of civilians, a person generally has already acquired the cues necessary to successfully identify an individual as representative of a police officer. Thus, the familiarity of an option in long term memory often leads to its selection.

Although useful in many situations, the potential for error is especially associated with the representativeness heuristic since ‘representativeness’ is not affected by other important factors, such as prior probabilities (Tversky & Kahneman, 1974). Tversky and Kahneman (1973) examined this claim by examining decision outcomes following the manipulation of prior probabilities. Participants were given several, brief personality descriptions based on several different individuals. These descriptions were sampled at random from 100 engineers and lawyers. Participants were asked to read the descriptions and for each, assess the likelihood that it had originated from an engineer or a lawyer. Participants were then assigned to one of two groups. In the first group, participants were informed that the group of professionals from which the descriptions originated consisted of a ratio of 70 engineers to 30 lawyers. In the second
group, participants were given the opposite ratio. The probability that a description belonged to an engineer should be higher in the first condition. However, participants from both groups gave the same probability judgements. Participants evaluated the likelihood that a description belonged to an engineer, rather than a lawyer based on the representativeness of the two stereotypes. Therefore, participants evaluated the probability by representativeness and chose to neglect prior probabilities (Tversky & Kahneman, 1973).

1.4.2 The Availability Heuristic

The availability heuristic is employed when a decision-maker assesses the probability and frequency of an event, based on the ease with which he or she recalls it from memory (Tversky & Kahneman, 1973; Tversky & Kahneman, 1974). This means that decision-makers will tend to judge an event to be more likely if it can be recalled easily. For example, Gabrielcik and Fazio (1984) observed that when participants were exposed, subliminally, to words containing the letter T, participants’ estimates of the frequency of T words increased significantly. The availability heuristic is relatively effective because the availability of the information in memory is generally determined by salience, frequency of use, and recency of use. For example, when sitting a multiple choice exam, although not logically deduced, the answer may be more available in memory simply because it has been read recently.

Like the representativeness heuristic, the availability heuristic is also subject to bias, since the selection of an option is based on memory recall rather than other, more objective sources of information (Tversky & Kahneman, 1974). For example, Tversky and Kahneman (1973) asked participants to read two lists of names. One list included the names of 19 famous men and 20 less than famous women, while the other included 20 famous women and 19 less than famous men. When asked to make an estimate in regards the number of men and women in
each list, participants’ estimated more men than women in the first list, and more women than
men in the second. This result was opposite to the ratios that actually existed, presumably
because the famous names were easily recalled than the less famous names.

1.4.3 The Anchoring and Adjustment Heuristic

The anchoring and adjustment heuristic is usually employed when a decision-maker is
asked to formulate an estimate by starting from an initial value and then adjusting this value
based on additional information (Tversky & Kahneman, 1974). Smith (1999) examined the
prevalence of the anchoring and adjustment heuristic among children and adults. He
demonstrated that when a person, either child or adult, was asked to make an estimate, his or her
second estimate was anchored by his or her initial estimate. For example, if asked whether the
population of New Zealand is more or less than two million, individuals will give one or the
other as their answer. If then asked what they think the actual population number is, they would
likely guess somewhere around the two million. The anchoring and adjustment heuristic can be
relatively effective in situations where decision-makers have little to no other information to
assist them in their estimates (Epley & Gilovich, 2006).

In the case of the anchoring and adjustment heuristic, the potential for error derives from
the fact that: 1) different individuals formulate different starting points for estimation; and, 2)
when an individual makes an adjustment to his or her initial estimate, the adjustment tends to be
insufficient due the anchoring of the initial estimation (Epley & Gilovich, 2006). For example,
Russo and Schoemaker (1989) asked participants to recall the last three digits of their telephone
number. They were then asked to add 400 to this number. Following this instruction, the
participants were asked “Do you think Attila the Hun was defeated in Europe before or after this
year (referring to the constructed number)?” The subjects were not told whether the event
occurred before or after. They were then asked “in what year would you guess Attila the Hun was defeated?” The estimates given by participants varied depending on the participants’ initial anchor, that is, their phone number plus 400.

On the basis of the current review, it is apparent that, although heuristics are a viable means of successful judgement, especially given the constraints on human processing (i.e., time-pressure, finite cognitive resources, and imprecise and/or incomplete sources of information), the attractiveness of heuristics is matched by their potential for error. Consequently, much research has sought a compromise between normative and descriptive approaches to decision-making theory and research.

1.5 INTEGRATING NORMATIVE AND DESCRIPTIVE APPROACHES TO DECISION-MAKING THEORY AND RESEARCH

There have been a number of attempts to integrate normative approaches (how people should decide) and descriptive approaches (how people actually decide). However, given the limitations associated with the application of normative procedures in some real-world environments, combined with the potential for error associated with the use of simplifying heuristics, a compromise between approaches has been difficult to establish.

One approach to the integration of normative and descriptive approaches has been to incorporate naturally occurring heuristic-based processes within Decision Support Systems (DSS) (Harris & Wiggins, 2008; Morrison et al., 2010; Wiggins & Bollwerk, 2006). DSS are generally designed to assist less-experienced decision-makers operate without compromising the integrity of a system (Chuang & Yadav, 1998; Gonzalez, 2005). By matching the way that individuals acquire and process information when using the DSS, to the underlying processes that they employ during unaided decision-making, heuristic-based DSS may reduce the cognitive
demands associated with real-world decision-making (Singh, 1998; Woods & Roth, 1988). Although quasi-rational decision engineering initiatives such as heuristic-based DSS enable less experienced operators to function at an acceptable level of performance (Morrison et al.), whether these devices enable the less experienced operator to acquire the necessary cognitive skills to develop expertise is less clear (Klein, 2005).

Expertise is presumed to derive from the acquisition of task-oriented experience, especially in dynamic environments where rapid decisions are required (Zsambok & Klein, 1997). Consequently, a branch of the descriptive approach, the naturalistic decision-making paradigm, has provided some degree of conciliation between descriptive and normative approaches, by prescribing those decision behaviours that occur in real-world environments based on descriptions of expert decision behaviours.

1.6 THE NATURALISTIC DECISION-MAKING PARADIGM: HOW TO HELP PEOPLE MAKE GOOD DECISIONS IN THE REAL-WORLD

In the context of decision research, the emergence of the Naturalistic Decision-Making (NDM) movement has represented something of a watershed. Rather than conceptualising decision-making as a cognitive process that is open to error, naturalistic decision theorists seek to identify those aspects of real-world decision making that enable accurate and efficient outcomes (Klein, 2008). As such, NDM research focuses on the identification of decision processes engaged by expert decision-makers in their domain.

NDM emerged from observations of the decision processes engaged by expert fire ground commanders (Klein et al., 1986). In particular, the researchers observed that these decision-makers, operating in naturalistic settings, would often generate a response without a systematic comparison between options, and further, showed remarkable accuracy and efficiency
Klein, Wolf, Militello, and Zsambok (1995) observed similar behaviours in expert chess players. Each player was asked to think aloud and trace four different moves, each originating from the same position. Each player was asked to formulate an initial response, then an alternative response, and so on. The moves were judged by the players themselves on a self-rating scale. These ratings gave a gauge of the players’ standard as to what they perceived as a good move. The results from these ratings suggested that the decision-makers’ first moves were as good as their level of skill allowed. In terms of how strong the players’ first moves were when compared to their subsequent second, third and fourth moves, it was considered by the chess masters that two thirds of the players’ first moves were adequate, while only 24 out of a possible 120 moves overall (i.e., including the players second, third and fourth moves) were considered adequate. These findings suggest that the players were able to generate a response without an analytical comparison between options and that this was generally effective in terms of performance.

These findings demonstrate a steep contrast to the decision processes prescribed in normative approaches, which require the generation of a large set of options and deliberation between such options. This suggests that highly analytical strategies may become less valuable as decision-makers progress towards expertise (Klein, 1997; 1998). This assertion has been supported by Driskell, Salas, and Hall (1994), who reported that the performance of experienced Navy operators declined when they were required to follow systematic procedures such as the review and deliberation of large amounts of information. Overall, these findings suggest that avenues for improving less experienced decision-makers’ performance may be identified simply by observing how experts make good decisions (Klein, 2008).
Although it can generally be concluded that information processing during decision-making is significantly influenced by decision-makers’ level of operational experience (Klein, 1993; Stokes, Kemper, & Kite, 1997; Wickens & Holland, 2000), only a limited number of studies (Bellenkes, Wickens, & Kramer, 1997; Fisher & Pollatsek, 2007; Schriver, Morrow, Wickens, & Talleur, 2008; Shapiro & Raymond, 1989; Sohn, & Doane, 2004; Stokes, Kemper, & Marsh, 1992; Wiggins & O’Hare, 2003) have attempted to vary aspects of the decision process systematically, to examine how they modulate the overall performance benefit observed in experts over novices. Indeed, if naturalistic researchers can identify the specific cognitive skills that differentiate performance across expertise, it may be possible to model expert decision processes in less experienced decision-makers.

Arguably, the naturalistic approach to decision-making theory and research is the most evolved of the approaches described here, as it aims both to understand (consistent with descriptive approaches) and to improve (consistent with normative and prescriptive approaches) human decision-making, and it does so with respect to the limitations associated with real-world, or naturalistic, environments. The current thesis will adopt the naturalistic approach to decision-making theory and research in an attempt to examine the specific cognitive features that differentiate decision quality across expertise.

1.7 CHAPTER TWO BRIEF

Chapter Two will explore the cognitive components that differentiate decision quality across expertise, with a special emphasis placed on the significance of cue-use during the decision-making process.
Chapter 2

THE COGNITIVE COMPONENTS THAT MODERATE DECISION QUALITY ACROSS EXPERTISE AND THE SIGNIFICANCE OF CUE-USE DIFFERENCES
“You see,” he explained, “I consider that a man's brain originally is like a little empty attic, and you have to stock it with such furniture as you choose. A fool takes in all the lumber of every sort that he comes across, so that the knowledge which might be useful to him gets crowded out, or at best is jumbled up with a lot of other things so that he has a difficulty in laying his hands upon it. Now the skillful workman is very careful indeed as to what he takes into his brain attic. He will have nothing but the tools which may help him in doing his work, but of these he has a large assortment, and all in the most perfect order.”

- Sherlock Holmes, in “A Study in Scarlet”
2.1 **CHAPTER OVERVIEW**

Chapter Two involves a discussion of the cognitive components of decision-making that moderate decision quality across expertise. In discussing these components, there is an emphasis on the prevalence of differences in cue-use across expertise and the proposition of cue-use as a cognitive mechanism that may differentiate performance across expertise. The chapter will conclude with a description of the thesis aims and stages of research.

2.2 **THE COGNITIVE COMPONENTS THAT MODERATE DECISION QUALITY ACROSS EXPERTISE**

On the basis of differences in observed decision performance across expertise (Ericsson & Lehman, 1996; Schriver et al., 2008; Wiggins & O’Hare, 2003; Wiggins, Stevens, Howard, Henley, & O’Hare, 2002), it might be concluded that differences exist in the decision-making process engaged by operators across different levels of expertise. However, besides the attribution of skill acquisition to the accumulation of operational experience (Dreyfus, Dreyfus, & Athanassiou, 1986; Ericsson, 2006), a relatively limited number of studies (Bellenkes et al., 1997; Fisher & Pollatsek, 2007; Schriver et al., 2008; Shapiro & Raymond, 1989; Sohn, & Doane, 2004; Stokes et al., 1992; Wiggins & O’Hare, 2003) have attempted to define the precise cognitive features that differentiate expert from non-expert decision-makers. Indeed, despite the utility of the expert-novice paradigm in establishing differences between expert and novice performance (Curran, Campbell, & Rugg, 2006; Enis, 1995), there has been relatively little research distinguishing the cognitive processes that occur during the stages between novice and expert.

In the context of cognition and information processing, decision-making involves at least three stages (Wickens & Flach, 1988). Firstly, the decision-maker perceives information and a
subset of this information (i.e., cues) is selected, based on previous knowledge and expectations. Secondly, these cues are evaluated and integrated to form an assessment or diagnosis, and, if necessary, generate options. Finally, the decision-maker considers potential responses and their outcomes, and selects and implements a response. Presumably, effective decision-making requires all three of these stages to be implemented successfully. Consistent with this perspective, Wickens and Hollands (2000) have outlined three cognitive components of information processing that may impact the quality of decisions, and presumably, play a role in differentiating performance across expertise.

The three cognitive components of information processing purported by Wickens and Hollands (2000) to impact decision quality include: cue-use; working memory limitations; and, long-term memory (access to past experiences). Each of these components will be discussed in detail in relation to their potential role in differentiating decision-making performance across expertise.

2.2.1 Cue-Use and Decision Quality across Expertise

Although the use of cues is often cited as a prominent factor in decision-making and diagnosis (Jones & Endsley, 2000; Klein, 1993), specific details concerning the nature of cues are often overlooked by researchers. As a result, cues are often qualified as mere information inputs in a larger computational process (St. John, Smallman, Manes, Feher, & Morrison, 2005). However, Wickens and Hollands (2000) suggest that cue-use represents a fundamental cognitive mechanism, which may impact decision quality and potentially moderate the differences in performance observed across expertise.

In the context of decision-making, cues, in their simplest sense, can be conceptualised as indicators of something meaningful in the navigation of an environment or scenario (Wiggins,
More specifically, a cue represents a concept, generally embodied in an environmental feature(s), which upon attending to it (selection), is able to cue the retrieval of associated concepts (and their representations, e.g., features) from memory (Wiggins, 2006; Wiggins & O’Hare, 2003). In this sense, cue selection involves the activation of an association, held in memory, between the cue (which is embodied in the environmental feature), and one or more other concepts stored in memory (Morrison, Wiggins, Bond, & Tyler, 2009; Wickens & Hollands, 2000). As such, each cue incorporates probabilistic, conceptual relations, which potentially enable a decision-maker to acquire meaning from the decision environment. For example, Abernethy (1994) observed that squash players did not possess sufficient time to respond to their opponent’s shots based on their reaction to the projected path of the ball. Instead, experienced players responded to changes in situational features, such as a variation in their opponent’s wrist movement, which would then cue them to the probable direction of the forthcoming shot.

The utilisation of cues by decision-makers suggests the existence of a network of cue-based associations in long-term memory that are designed to make the decision-making process less effortful (Klein, 1997; Wiggins, 2006). Indeed, the notion of associations in memory, that is, relationships stored in memory between two or more pieces of information (or items), is a fundamental concept in memory and cognition (Ackerman & Rathburn, 1984; Anderson, 1993). Models that posit the existence of associations in memory are generally termed models of associative memory.

Numerous models of associative memory posit a set of nodes connected by links. These nodes may represent information such as words or environmental features and the links are then weighted based on the strength of the association between the nodes (Gillund & Shiffrin, 1984).
The strength of association between nodes is said to be a product of Hebbian learning (Bishop, 1995), whereby the simultaneous activation of nodes leads to increases in the strength of association between them. Here, the processing of information is presumably based on a spreading activation, whereby the observation of external stimuli may trigger the activation of a node that may spread activation to a node with which it is associated (Collins & Loftus, 1975).

The existence of such associative networks is well-supported empirically, particularly from research concerning long-term memory. For example, Meyer and Schvaneveldt (1971) examined participants’ information search within long-term memory to determine whether concept-relatedness impacted memory retrieval rates in a Lexical Decision Task. In the Lexical Decision Task, participants are presented with words (e.g., *cat*) and pseudo words (e.g., *blar*), and are asked to determine, as quickly as possible, whether or not the item presented is a valid word (Neely, Keefe, & Ross, 1989). Theoretically, such a decision involves participants searching their lexicon; a network of words stored in memory that contains information about the word’s meaning, its use, and its relationship to other words. Participants’ response latency in making their decision is recorded and is indicative of the time required to search the lexicon to find the word. The researchers presented items in pairs to examine the potential effects of priming on participants’ information search. Priming occurs when the presentation of one item (a prime) (e.g., *sky*) accelerates the response to a succeeding, related item (a target) (e.g., *blue*) (McNamara, 1994). They demonstrated that response latency to the second item was shortest when it was a word, and when the first item in the pair was a word that was semantically associated. On the basis of these findings, the researchers concluded that when primed with a word, activation would spread to nodes that were meaningfully related; supporting the existence of associative networks in memory whereby node activation may be primed or cued.
One specific model of associative memory is the Search of Associative Memory (SAM) model (Raaijmakers & Shiffrin, 1980). In SAM, both the acquisition and the strengthening of an association in long-term memory are based on the co-occurrence of items in working memory. Items that co-occur more often become more strongly associated, resulting in a greater capacity to retrieve related items from memory (Gillund & Shiffrin, 1984). Presumably, these items are connected to each other through experience and learning (Colins & Loftus, 1975). For instance, the node representing fire may become connected to the node representing smoke because smoke is a strongly associated property of the concept fire, with the two co-occurring consistently.

Although associative models may incorporate holistic representations of conceptual relations, some models of associative memory posit that, in learning the meaning of a concept (e.g., dog), a certain pattern of features (e.g., fur, tail, paws) may come to represent the concept. Therefore, the knowledge of a concept is distributed over many different features so that a relationship between concepts may be recognised based on the observation of specific features (i.e., cues) within a given scenario (Anderson, 1990).

The notion of concepts being characterised by specific features is evident in an associative model of memory developed by Anderson (1983; 1993); the Adaptive Control of Thought-Rational (ACT-R). The model posits that chunks or conceptual categories in memory carry a label, a set of defined relationships to other chunks, and any number of chunk-specific features. As in other associative models, chunks can be mapped in a network, whereby each chunk represents a node, and each link is the node’s relationship to another node. In ACT-R, an association’s strength decreases as a function of the time since it was created, and increases with the number of times that it is activated. In sum, ACT-R describes a network of conceptually related chunks which, theoretically, may be accessed through the use of cues.
Consistent with these associative models of memory, it is proposed that decision-makers will trigger meaningful conceptual relations in memory when primed by salient cues in the environment. These cue-based associations may then signal the probable co-occurrence of stimuli in the environment, which may enable a decision-maker to predict the occurrence of an event (i.e., if A is observed, then it is likely that B will follow), or similarly, diagnose an event that has transpired (i.e., if B is observed, then A was likely to be involved somehow) (Waldman & Holyoak, 1992).

As the establishment of cue-based associations appear to be dependent on experience (Bishop, 1995), the effectiveness with which cues are selected/employed may be moderated by a decision-maker’s level of expertise in a given domain. Indeed, in numerous domains, including fire-fighting (Klein, et al., 1986), medical diagnoses (Hammond, Frederick, Robillard, & Victor, 1989), courtroom judgments (Ebbesen & Konecni, 1975), aviation (Stokes et al., 1992), chess (de Groot, 1966), finance (Hershey, Walsh, Read, & Chulef, 1990), driving (Fisher & Pollatsek, 2007), and nursing (Shanteau, 1991), the use of cues has been demonstrated to vary with expertise, to the point where an expert decision-maker may only target a limited set of environmental cues to formulate a decision (Jackson, Warren, & Abernethy, 2007; Shanteau, 1992b). Further, these expert-oriented cues tend to be high in diagnosticity, that is, they possess a high degree of predictive validity or relevance to diagnosis (Schriver et al., 2008). In comparison, non-expert decision-makers reportedly target a greater number of less relevant cues across scenarios (Boreham, 1995; Kirschenbaum, 1992; Stokes et al., 1992). For example, in the aviation domain, expert pilots spend more time examining relevant cues than non-experts during failures which require diagnosis (Morrow, Miller, Ridolfo, Magnor, Fischer, Kokayeff, et al., 2009; Schriver et al., 2008), and use more relevant cues than non-experts when making weather-
related decisions (Wiggins & O’Hare, 2003). These differences in the use of cues during the negotiation of complex tasks, may, in part, differentiate performance across expertise.

Indeed, experts appear to make better (i.e., more accurate and timely) decisions than non-experts, in part, because of their superior capacity to target and use appropriate cues. For example, Stokes et al. (1992) demonstrated that the percentage of relevant cues targeted by expert pilots compared to novices was the best predictor of decision performance. Similarly, Schriver et al. (2008) found that attention allocated to relevant cues among expert pilots was associated with a high degree of decision accuracy. Moreover, the benefits associated with expertise can be reduced for complex tasks through the absence of relevant cues (Beilock, Wierenga, & Carr, 2002), presumably since experts are unable to exploit their previous experience with a situation.

On the basis of the preceding discussion, it might be concluded that expertise-related performance differences stem partly from more effective cue-use by experts over novices. Moreover, this difference in cue-use may also moderate the second component of decision quality posited by Wickens and Hollands (2000); working memory limitations.

2.2.2 Working Memory Limitations and Decision Quality across Expertise

Humans, as information-processors, are subject to limitations in the distribution of cognitive resources, such as working memory (Simon, 1997). Generally, as the amount of information to be held in working memory is increased over a period of time there is a reduction in the cognitive resources available for the processing of information; potentially resulting in increases in cognitive load, and concomitant decrements in performance (Chandler, & Sweller, 1991). However, working memory limitations have been demonstrated to vary across decision-makers as a function of expertise.
Experts’ superior capacity to exploit working memory was demonstrated by Chase and Simon (1973), who examined chess players’ recall of randomly placed chess pieces on a chess board. The authors compared recall accuracy across different levels of chess proficiency. They found that the ability to recall the location of chess pieces increased as a function of chess expertise, with beginners able to recall, on average, four pieces, compared to experts, who recalled virtually all twenty pieces. Further, the authors established that when a chess position was located in a position inconsistent with the normal display of a chessboard, a similar level of recall ability to that seen for normal displays was evident amongst the experts. This suggests that the superior performance of experts was not due to an increased memory capacity, but rather, the manipulation of information represented in working-memory.

Similar differences in information management across expert and novice chess players were observed by Newell and Simon (1972). The authors concluded that experienced chess players were able to chunk the stages of a chess game into subcomponents or associated features. Thus, expert players were able to retain more information in working memory through the use of associations.

In addition to differences in both the number and the strength of associations between concepts within a particular domain (Anderson, 1993), Newell and Simon (1972) propose that experts retain a relatively greater number of features that may define each concept (and thus, more cues capable of triggering an association), and a greater number of interrelations between the concepts, than non-experts. These findings suggest that experts tend to manage information differently to novices and that this superior management of information may, in part, explain differences between expert and novice performance.
Indeed, experts’ effective use of associations may reduce the demands on working memory, potentially explaining both the capacity of expert decision-makers to respond rapidly and accurately, and their capacity to manage multiple tasks simultaneously (Klein et al., 1986). In the case of novices, a specific cue may trigger an association with a number of relatively general events, none of which pertain specifically to the situation being encountered. The need to manipulate this information in working memory may result in a greater cognitive load and relatively poorer decision-making performance (Sweller, 1988). Accordingly, the value of effective cue-use in information processing may lie partly in its capacity to obviate the requirement for extensive working memory resources to initiate a response.

Consistent with the previous discussion of cue-use and decision quality, the discussion on working memory limitations supports the previous assertion that the effective use of cue-based associations partly moderates the observed differences in decision performance across expertise, in this instance, by reducing the impact of working memory limitations during information processing. As a decision-maker’s acquisition of cues is presumably based on previous exposure to decision cases, this suggests that effective cue-use is also strongly associated with Wickens and Hollands’ (2000) third moderating component of decision quality; decision-makers’ access to past cases stored in long-term memory.

### 2.2.3 Long-term Memory and Decision Quality across Expertise

As decision-makers gain domain-specific experience, they are able to use past instances of the task, presumably stored in long-term memory, which may assist them in developing mental models of a given situation (Klein, 1997). A mental model is an internal representation of the external world (Markham, 1999; Johnson-Laird, 1983) that specifies the relationship between concepts (Cannon-Bowers et al., 1993). Indeed, when observing the decision process engaged
by expert fire-ground commanders, Klein et al. (1986) observed that these decision-makers would rarely engage in systematic comparison between options, as evident in novice operations (Boreham, 1995). Instead, they engaged a form of recognition-primed decision-making (RPDM) to make appropriate responses (Klein, 1993).

Klein (1993) has postulated that the expert, having sufficient experience, is able to recognise the parameters of a situation based on a kind of match with past cases stored within long-term memory. This recognition of familiarity then sensitises the decision-maker to the goals, consequences, and cues that are critical to a successful response. This proposition was supported by Bellenkes et al. (1997) who demonstrated that expert pilots were able to construct mental models based on previous cases and use these mental models to target relevant environmental cues. Thus, it appears that access to previous cases in long-term memory allows experts to attend more easily to relevant information (cues) when making decisions (Khoo & Mosier, 2005).

Indeed, one salient process described in Klein’s (1993) RPDM model is the instantaneous recognition of seemingly critical cues by expert operators. These cues are critical in the sense that the triggering of a limited number of associations often circumvents the need for a further information search (Klein et al., 1986). As alluded to earlier, this suggests that the cues available in the environment will vary in relation to their representativeness of the system state; that is, their level of diagnosticity.

Because cues vary in diagnosticity (Schriver et al., 2008), a determinant of expertise may be one’s ability to recognise and target highly diagnostic cues that may reduce the time and effort required during diagnosis. This capacity to recognise cue diagnosticity most likely occurs through the accumulation of past cases in long-term memory, and feedback in relation to
decision outcomes (Wickens & Hollands, 2000). On the basis of the performance-related feedback, it is presumed that decision-makers will identify those cues that are more diagnostic and, ultimately, pay more attention to such cues (Schrider et al., 2008). This is consistent with Shanteau’s (1992a) conclusion that experts are better able to discriminate between stimuli, and, presumably, between cues, based on their relative usefulness. Accordingly, it might be argued that experts’ superior access to past cases stored in long-term memory, compared to non-experts, aids in their effective selection and use of cues, which appears to be a key differentiating factor in decision quality across expertise.

2.3 THE SIGNIFICANCE OF CUE-USE DIFFERENCES ACROSS EXPERTISE

The preceding discussion indicates that effective cue-use is central to each contributing component of decision quality proposed by Wickens and Hollands (2000): cue-use, working memory limitations, and long-term memory. On the basis of the literature reviewed, the progression to expertise appears to involve a qualitative shift in information processing. As a decision-maker accumulates task experience, he or she will gain the capacity to make decisions in complex situations based on the recognition and interpretation of key cues in the environment (Lipshitz, Klein, Orasanu, & Salas, 2001; Klein, et al., 1986). As such, decisions can be made based on relatively fewer (more diagnostic/relevant) cues (Shanteau, 1992b), as experts use a recognition-primed process to filter relevant from irrelevant cues (Klein, 1998). In sum, experts, based on their experience, appear to target the right cues more readily than novices.

As cues (and their associations) are typically acquired via operational experience, it is argued that the inferior cue-use observed in novices is predominantly due to limitations in previous experience, which results in the overgeneralisation of knowledge accumulated from a relatively limited number of cases. Thus, novices can make the erroneous assumption that a
situation is *familiar* based on a relatively limited number of general cues (Wiggins, 2006), and consequently, are more likely to misinterpret the situation.

As the appropriate targeting and activation of cues appears central to proficient decision-making across a number of domains: fire-fighting (Klein et al., 1986); medical diagnoses (Hammond et al., 1989); courtroom judgments (Ebbesen & Konecni, 1975); aviation (Stokes et al., 1992); chess (de Groot, 1966); finance (Hershey et al., 1990); driving (Fisher & Pollatsek, 2007); and nursing (Shanteau, 1991), there are significant implications for inappropriate or ineffective cue-use. Further, since expert cue-use invariably correlates with higher levels of performance in complex tasks (Stokes et al., 1992), attempts to improve novice performance are likely to be assisted through the examination, identification, and utilisation of expert cues. Here, the aim is not to identify an exhaustive catalogue of every expert cue within an expert decision-maker’s repertoire, but rather, to identify a limited number of highly diagnostic cues that may distinguish expert from novice decision-making.

By identifying an expert cue set within a specific domain, it may be possible to enable novices to target a number of cues that they would not otherwise engage. This is consistent with previous research involving cue-based training in which non-experts have been taught to attend to those environmental features employed by experts (Bellenkes et al., 1997; Shapiro & Raymond, 1989; Wiggins & O’Hare, 2003). For example, modelling expert scanning patterns has been shown to successfully improve novice driving performance (Fisher & Pollatsek, 2007). The aim of this type of research has been to expose the learner to cues that are useful as *triggers* for diagnosis. However, while this form of training has been found useful for improving novices’ attention management skills, the capacity for trainees to trigger meaningful associations in memory remains limited (Beilock et al., 2002). A feature will only operate as a cue when its
observation leads to the activation of an association(s) in memory. Thus, whether a feature represents a cue, and what information it cues (i.e., the associations), may be factors that remain to differ across expertise.

Although it is consistent with the principles of cue-based training, the current work extends this approach by not only exposing learners to expert cues (i.e., improving cue selection), but also, exposing them to a limited number of expert associations between cues and other relevant concepts, typically triggered during expert decision-making. The aim is to aid non-experts in both the successful recognition and selection of relevant cues and the timely interpretation of these cues. In this type of training, novices are taught to seek out salient environmental cues and to retrieve associated concepts from memory, which potentially provides some level of meaning, thereby aiding situational assessment and diagnosis. Moreover, consistent with Chater and Oaksford’s (2007) claims, it is hypothesised that an explicit explanation of the relationship between the elements of cues is likely to increase the rate at which those cues are acquired.

In summary, it is hypothesised that, through an expanded form of cue-based training, novices will be able to both attend to critical information in the environment, and circumvent the limitations of working memory typically observed in novice processes, resulting in more accurate and timely decisions. Thus, this work seeks not only to model expert cues, but to model expert activation. Moreover, by systematically reducing the differences in cue activation (and presumably use) across expertise, it will be possible to develop an understanding of the precise role of cues in the development of expertise, and whether differences in cue-use are a precursor to, or a reflection of, expertise. If these differences are found to be a precursor, the need for a
vast degree of operational expertise may indeed be partly circumvented, via novices’ acquisition of expert cues-based associations.

2.4 THESIS AIM

This thesis adopts the naturalistic decision-making approach to theory and research (outlined in Chapter One) to examine a specific cognitive component of decision-making, cue-use, and examine how this process may differentiate performance across expertise. Specifically, the aim of this thesis is to investigate potential differences in cue activation (and presumably use) across two stages of expertise (expert and novice), and to determine whether it is possible to improve novice decision-making performance based on a modelling of expert cue activation. This involves several specific objectives across three studies outlined here.

2.4.1 Study 1: The Identification of Potential Cues and their Associated Concepts from Experts and Novices

Study 1 was designed to identify a number of potential cues and the associated concepts that reside in memory, as used by two classes of decision-maker; expert and novice. This study embodied three specific aims: firstly, to extract a number of features that decision-makers target in an operational environment (potential cues); secondly, to extract a number of features which, when cued, would be retrieved from memory; and, finally, to collapse these two groups of features into concept labels which represent the potential cues used and the associated concepts retrieved from memory. These concept labels were to be used as a basis for discriminating between expert and novice cue activation using an adapted paired association task (Study 2).
2.4.2 Study 2: Measuring Conceptual Associative Strength as a Means of Distinguishing Cue Activation across Expertise, Validating Qualitative Outcomes, and Identifying an Inventory of Expert Cue-Based Associations

Study 2 was designed to examine the utility of an adapted, paired association task as a basis for discriminating expert and novice cue activation. Two phases of study are reported, the first of which (Study 2a) presented pairs of concept labels as part of a Paired-Concept Association Task (P-CAT), which examined participants’ response latency in recognising associations (cue activation). This task was designed to objectively measure the relative strength of associations between cues and the concepts that may be retrieved from memory across expertise. It was expected that the outcomes of this study would lead to the identification of the strongest expert cues and their associations that could be used within a cue-based training program (Study 3). The second phase (Study 2b) involved the distribution of a survey to further examine participants’ perceptions of the associations between concepts. The survey was used to explore the basis of the expected differences in response latency by examining expert and novice perceptions of the frequency of use, strength, domain specificity, and diagnosticity, of a number of associations recognised by experts and novices.

2.4.3 Study 3: The Impact of Associated Concepts Exposure (ACE) Training on Cue Activation and Decision Performance

Study 3 was designed to investigate whether novices’ acquisition of the expert-cue-based associations was beneficial to their decision-making performance. Two phases are reported. The first phase (Study 3a) employed an experimental training program, Associated Concepts Exposure (ACE), to aid naïve participants’ acquisition of a number of expert cue-based associations. It was designed to determine whether exposure to expert associations, in a manner
consistent with the P-CAT presentation (i.e., concept pairings in the absence of contextual variables), results in a significant improvement in participants’ recognition of expert cue-based associations (as assessed by the P-CAT).

The second phase of the study (Study 3b) again used ACE training to teach a set of expert cue-based associations to participants; this time to novice participants, who possessed some degree of awareness of the operational context. This phase of study was designed to determine whether potential improvements in novices’ recognition of expert associations results in concomitant improvements in several facets of decision-making performance, including decision accuracy, decision efficiency, and information acquisition. This phase also sought to determine whether potential improvements in novices’ decision performance are impacted by the extent to which the decision scenarios engaged reflects a naturalistic setting.

Three tools were employed in Study 3: the ACE training program; the P-CAT; and, a decision assessment interface. The assessment interface operated as a surrogate for the operational environment, enabling users to explore, acquire, and integrate cue-based information in quasi-realistic decision tasks. The interface was used to assess participants’ overall decision performance, including performance variables such as decision accuracy, time to complete, and information acquisition. The interface was administered prior to, and subsequent to, ACE training. A diagrammatic representation of the proposed stages of research is shown in Figure 2.1.
In conducting the proposed research, a context in which to explore cue-use across expertise was necessary. Although cue-use has been examined in numerous decision-making contexts: fire-fighting (Klein et al., 1986); medical diagnoses (Hammond et al., 1989); courtroom judgments (Ebbesen & Konecni, 1975); aviation (Stokes et al., 1992); chess (de Groot, 1966); finance (Hershey et al., 1990); driving (Fisher & Pollatsek, 2007); and nursing (Shanteau, 1991), the domain of *offender profiling* offers a unique opportunity for studying cue-use in complex decision scenarios, across expertise. The use of offender profiling as an operational context for the current research is discussed in Chapter Three.
OFFENDER PROFILING AS A CONTEXT FOR EXAMINING CUE-USE ACROSS EXPERTISE
“And the murderer?”

“Is a tall man, left-handed, limps with the right leg, wears thick-soled shooting-boots and a gray cloak, smokes Indian cigars, uses a cigar-holder, and carries a blunt pen-knife in his pocket. There are several other indications, but these may be enough to aid us in our search.”

- Lestrade and Holmes, in “The Boscombe Valley Mystery”
3.1 CHAPTER OVERVIEW

Chapter Three will briefly detail and justify the use of offender profiling as a context for examining cue-use across expertise in the current thesis.

3.2 OFFENDER PROFILING

Offender profiling or, more simply, profiling, is a rapidly emerging practice, which involves the application of psychological principles regarding human behaviour to the investigation of a criminal act (Canter, 2000). As an investigative tool, profiling holds the promise of effectively narrowing a vast population of suspects by offering a profile, a compilation of both physical and psychological characteristics (e.g., age, sex, marital and employment status, personality type, etc.), of the unknown offender in question (Davis, 1999; Wilson, Lincoln, & Kocsis, 1997). For example, in the New York City Mad Bomber case, a criminal psychiatrist correctly instructed police to look for a heavy man, middle-aged, foreign born, Roman Catholic, single, living with a brother or sister, wearing a double breasted suit (Brussel, 1968). Predictions such as these are generally based on inferences drawn from the offender’s physical, sexual, and, in some cases, verbal interaction with his or her victim(s) (Douglas, Burgess, Burgess, & Ressler, 1992).

Although the domain of profiling has expanded to include practices such as anticipating hostage scenarios (Woodworth & Porter, 1999) and assessing letters of threat (Wilson et al., 1997), the majority of profiling practices are concerned with the investigation of predominantly violent crimes (Holmes & Holmes, 1996; Vorpagel, 1982). Moreover, profiling has been particularly useful in cases of violent sexual homicide where there is both a difficulty in identifying motive, and pressure to apprehend the offender as quickly as possible (Canter, 2000). During the investigation of such crimes, a profile typically guides an investigation by either
matching the profile with a pool of suspects or by offering a compilation of offender characteristics from which potential suspects may be identified and apprehended.

Most approaches to profiling depend on two basic premises: behavioural consistency across offences and stable relationships, or associations, between configurations of offence behaviours and background characteristics (Canter, 2000). The most frequently cited associative model of offender behaviour is used by agents from the Behavioural Analysis Unit of the Federal Bureau of Investigation (FBI). This process, referred to as *Criminal Investigative Analysis*, involves an initial crime scene assessment whereby the profiler will seek out salient crime scene indicators (Douglas et al., 1992). These indicators, which are generally embedded in features relating to the forensic findings, victimology, and criminal act itself, are said to offer the profiler information indicative of the offender’s characteristics (e.g., age, sex, etc.). As indicators trigger the retrieval of associated information from memory, it is presumed that they are largely consistent with the conceptualisation of cues detailed in Chapter Two.

*Crime → offender* associations form the basis of the FBI’s inductive profiling process (Hazelwood, Ressler, Depue, & Douglas, 1995). The use of these associations is often justified based on an examination of prior statistical probabilities relating to correlations between crime-related and offender-related information (Woodworth & Porter, 1999). An example of a possible association used by an FBI profiler is illustrated in Figure 3.1.
Although a number of different profiling techniques are employed by law enforcement agencies across the world (Kocsis, Irwin, Hayes, & Nunn, 2000), the use of associations (i.e., cue-use) forms the basis of the decision-making process by expert profilers across a range of methods (Turvey, 1999; Wilson et al., 1997). Accordingly, the prominent and complex use of cues during profiling makes it the ideal operational context for the current research, especially when considering the clear distinction in profiling (decision) performance across expertise.

Like other skilled professions, a professional, or expert profiler may represent the highest level of expertise (i.e., one end of the continuum), compared to competent profilers, such as detectives (i.e., middle of continuum), novice profilers, such as students from relevant learning backgrounds associated with the field (e.g., policing, forensics, psychology, criminology) (i.e., other end of continuum), and naïve individuals, who have no awareness of the field (i.e., starting end of continuum) (Douglas et al., 1992; Dreyfus et al., 1986; Hazelwood et al., 1995; Kocsis et al., 2000; Turvey, 1999).

Differences in profiling performance across expertise have been demonstrated by Kocsis et al. (2000), who reported that expert profilers significantly outperformed both competent and naïve profilers in formulating accurate profiling decisions. Consistent with the proposition that

**Figure 3.1.** An illustrated example of a possible profiling association used by an FBI profiler.  

<table>
<thead>
<tr>
<th>CRIME-RELATED INFORMATION</th>
<th>OFFENDER-RELATED INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian Victim Murdered</td>
<td></td>
</tr>
<tr>
<td>Caucasian Offender</td>
<td></td>
</tr>
<tr>
<td>(86% of time (Bureau of Justice Statistics, 2008))</td>
<td></td>
</tr>
</tbody>
</table>
potential cue-use differences across expertise may, in part, differentiate expert from novice
decision performance (proposed in Chapter One), it is theorised that cue-use, during the practice
of profiling, may be a differentiating factor in the observed differences in profiling performance
(Kocsis et al.).

Indeed, the proposed superior cue-use by expert profilers may begin to explain the often
described, and criticised, intuitive nature of the profiling process (Muller, 2000). This automatic
style of processing is consistent with Klein’s (1993) Recognition-Primed Decision-Making
(RPDM) model of decision-making (detailed in Chapter Two) as, generally, an expert profiler
will not generate/compare options, but instead, recognise meaningful environmental cues that act
as the catalyst for a successful response (Woodworth & Porter, 1999).

3.3 Conclusion

Offender profiling represents a relatively complex context that encapsulates a broad
range of associations, and embodies a clear distinction between expert and non-expert decision
performance. As such, profiling offers an ideal opportunity for the current research to examine
the role of cues in the development of expertise.

3.4 CHAPTER FOUR BRIEF

Chapter four will feature Study 1, which sought to elicit potential offender profiling cues
and their associated concepts from expert and novice profilers.
STUDY 1: THE IDENTIFICATION OF POTENTIAL OFFENDER PROFILING CUES AND THEIR ASSOCIATED CONCEPTS FROM EXPERT AND NOVICE PROFILERS
“As a rule, when I have heard some slight indication of the course of events, I am able to guide myself by the thousands of other similar cases which occur to my memory.”

- Sherlock Holmes, in “A Study in Scarlet”
4.1 **STUDY OBJECTIVE**

Study 1 was designed to identify a number of potential cues, and their associated concepts that may reside in memory, as used by two classes of profiler; expert and novice. This study had three specific aims: 1) to identify a number of feature descriptions that the profilers may target in an operational environment (potential cues); 2) to identify a number of feature descriptions relating to an unknown offender, that profilers might retrieve from memory when cued; and, 3) to collapse these two groups of feature descriptions into concept labels which represent the potential environmental cues used (crime-related concept labels) and the associated concepts (offender-related concept labels) retrieved from memory. These concept labels will be used as a basis for discriminating expert and novice cue activation (and presumably use) using an adapted paired association task (detailed in Study 2).

4.2 **BACKGROUND/RATIONALE**

A number of different methodologies have been developed to identify and elicit cue-based information from subject-matter experts. Generally, the aim of these techniques has been to investigate the aspects of the process that discriminate experts from novices by transcending the common knowledge and formalised procedures employed by decision-makers to complete routine tasks (O’Hare, Williams, Wiggins, & Wong, 2000). The vast majority of these efforts have involved the use of some form of *Cognitive Task Analysis*.

Cognitive Task Analysis (CTA) is an approach that investigates the cognitive processes required to complete a task at a relatively high level of difficulty (Crandall, Klein, & Hoffman, 2006). Generally, this method is used for tasks that are cognitively complex, that is, they are of high consequence (i.e., critical), high information content, and occur within the constraints of
real-world operation (Redding & Seamster, 1994). The most common form of CTA involves the use of cognitive interviews (Seamster, Redding, & Kaempf, 1997).

The cognitive interview involves the delivery of questions relating to an event or series of events that are recalled by an individual (Geiselman & Fisher, 2008). Generally, the technique is based on the application of information encoding specificity principles, whereby the recreation of an event in one’s mind generally improves the recall of detail (Tulving, 1982; 1983). The format of the cognitive interview can be divided into two major techniques. The first, the think-aloud interview technique, is derived from the work of Ericsson and Simon (1993) in which participants are instructed to read several survey questions, and think aloud as they attempt to answer them. This technique generally requires a form of pre-interview training from the interviewer to inform the interviewee of the type of information that should be relayed (Ericsson & Simon, 1987; van Someren, Barnard, & Sandberg, 1994; Whitney & Budd, 1996).

The second cognitive interview technique is verbal probing (Willis, 2005). The interviewer asks the interviewee several questions regarding the events of interest and then probes for more specific information subsequent to the question being answered. These probes often involve the request for further interpretation, paraphrasing, confidence judgements, recall of specifics, and generalisations (Conrad & Blair, 2004). Cognitive interview probing generally takes two forms: retrospective and concurrent.

In retrospective probing, the interviewee is asked probing questions subsequent to the interview process (Willis, 2005). This type of probing is useful when the primary purpose of the interview is to determine the interviewee’s ability to solve/diagnose a problem situation. Concurrent probing, on the other hand, involves the interchange between the interviewee’s recall of events, and the interviewer’s probing, allowing a real-time conversation between the two
Concurrent probing is useful when attempting to gather information regarding specific processes engaged by the interviewee (Beatty & Willis, 2007). This latter form also allows the interviewer a greater degree of control in respect to the issues that he/she wishes to explore, and ultimately, more scope in regard to what the researcher wants to gain from the interview(s) (Willis, 2005).

In recent years, a refined version of the cognitive interview technique has been developed specifically for use in the field of naturalistic decision-making research. The technique, known as the Critical Decision Method (Klein, Calderwood, & MacGregor, 1989), involves the interviewer using specially designed probes to extract information pertaining to the decisions made by the interviewee during a critical incident, and, more specifically, the goals, strategies, and cues involved in the decision-making process.

4.2.1 The Critical Decision Method

The Critical Decision Method (CDM) is a knowledge elicitation strategy modelled on Flanagan’s (1954) Critical Incident Technique. The CDM is based upon Klein’s (1993) recognition-primed decision model, which posits that, when confronted with a familiar situation, an experienced decision-maker will spontaneously construct a mental model of the situation, which constitutes the goals, strategies, and cues involved in completing the task successfully. The CDM uses a set of cognitive probes to elicit information pertaining to each of these facets of the process (Hoffman, Crandall, & Shadbolt, 1998). Indeed, a unique aspect of the CDM compared to many other cognitive interview strategies is its use of cognitive probes specifically designed to elicit information regarding a decision-maker’s use of cues and their associated concepts. A list of potential CDM interview probes as used by Klein et al. (1989) is shown in Table 4.1.
Table 4.1.

A List of Useful Probing Questions Used in the CDM as Proposed by Klein et al. (1989).

<table>
<thead>
<tr>
<th>Probe Type</th>
<th>Probe Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cues</td>
<td>What were you seeing, hearing, smelling…?</td>
</tr>
<tr>
<td>Knowledge</td>
<td>What information did you use in making this decision, and how far was it obtained?</td>
</tr>
<tr>
<td>Analogues</td>
<td>Were you reminded of any previous experience?</td>
</tr>
<tr>
<td>Goals</td>
<td>What were your specific goals at this time?</td>
</tr>
<tr>
<td>Options</td>
<td>What other courses of action were considered by or available to you?</td>
</tr>
<tr>
<td>Basis</td>
<td>How was this option selected/other options rejected? What rule was being followed?</td>
</tr>
<tr>
<td>Experience</td>
<td>What specific training or experience was necessary or helpful in making this decision?</td>
</tr>
<tr>
<td>Aiding</td>
<td>If the decision was not the best, what training, knowledge, or information could have helped?</td>
</tr>
<tr>
<td>Time Pressure</td>
<td>How much time-pressure was involved in making this decision?</td>
</tr>
<tr>
<td>Situation Assessment</td>
<td>Imagine that you were asked to describe the situation to a relief officer at this point, how would you summarise the situation?</td>
</tr>
<tr>
<td>Hypotheticals</td>
<td>If a key feature of the situation had been different, what difference would it have made in your decision?</td>
</tr>
</tbody>
</table>
The CDM attempts to disambiguate processes that are usually associated with the operator’s limited opportunity for conscious deliberation and is, therefore, commonly used to investigate aspects of expertise (Crandall & Getchell-Reiter, 1993). In the CDM, the interviewer asks the interviewee to recall non-routine cases to ensure a high degree of complexity, which will draw on specific skills, processes, and cues that may be largely unknown to non-expert operators (Hoffman et al., 1998). The CDM’s use of non-routine cases also works to encourage a higher level of reasoning, which promotes the recall of tacit knowledge, compared to routine cases, which may promote the recall of formalised procedural knowledge already known to non-experts (Klein et al., 1989).

Although hypothetical questions may be posed to the interviewee, generally, the CDM is retrospective in nature, requiring the interviewee to recall previously encountered critical incidents and the decision processes engaged at the time (Crandall & Getchell-Reiter, 1993). Consequently, in its current form, the application of the CDM for use in non-expert samples is not feasible, as their limited operational experience will presumably impede their capacity to generate useful incidents for deliberation.

As an overall aim of the current work is to discriminate between expert and novice cue utilisation in the context of offender profiling, it is important to gain insight into the decision processes engaged by both experts and novices, and how each group of profilers will approach the same task. As such, the current work employed a modified version of the CDM that enabled the analysis of both expert and novice decision processes, by providing interviewees with pre-selected, detailed descriptions of non-routine critical incidents, and recording interviewee responses to these incidents in real-time, as they encounter the incident. This modified version of
the CDM, which will be referred to as the Real-Time CDM, will use a combination of think-
aloud and concurrent probing techniques to examine specific instances of cue-use.

4.3 A IM

The aim of Study 1 was to identify a number of potential cues, and their associated concepts, used by two classes of profiler; expert and novice. This involves three specific stages: 1) identify a number of feature descriptions that the profilers may target in an operational environment (potential cues); 2) identify a number of feature descriptions relating to an unknown offender, that profilers might retrieve from memory when cued; and, 3) collapse these two groups of feature descriptions into concept labels which represent the potential environmental cues used (crime-related concept labels) and the associated concepts (offender-related concept labels) retrieved from memory. These concept labels will be used as a basis for discriminating between expert and novice cue activation (and presumably use) using an adapted paired association task (detailed in Study 2).

4.4 M ETHOD

4.4.1 Participants

As a vast range of profiling practices exist, it was essential to elicit information from profilers from a range of education and training backgrounds. The participants for Study 1 were drawn from two sources: 1) Ten expert profilers (nine male and one female, mean age = 46 years) were recruited from a pool of forensic, behavioural, and psychological analysts, with extensive operational experience in the domain of offender profiling. These experts were drawn from several profiling backgrounds, including, Criminal Investigative Analysis, Geographical Profiling, Investigative Psychology, Criminology, and Cognitive Behavioural Psychology. These profiling experts were drawn from three different countries, including: Australia (Melbourne),
Canada (Ottawa), and the United States (Sacramento CA, Oklahoma City OK, Manassas VA, Fredericksburg VA, Alexandria, VA, Fayetteville NC, Goldsboro NC, and Washington D.C.); 2) Ten novice profilers (five male and five female, mean age = 22.5 years) were drawn from several learning areas associated with the practice of offender profiling, including, Behavioural Science, Behavioural Evidence Analysis, Forensic Science, Forensic Psychology, and Policing/Criminology.

As the participants’ profiling accuracy was not assessed prior to participation in the study, expertise was defined according to Shantaeu’s (1984) approach to expertise distinction, which adopts the concept of relative expertise. According to this approach, the novice is identified and the expert is defined relative to the novice on a continuum of expertise. This approach assumes that expertise is a level of proficiency to which novices are able to progress. The level of proficiency can then be assessed grossly in terms of years of operational experience, appropriate qualifications within the domain, a history or reliable methods and accurate outcomes, supervisory roles, and recognition among peers within the domain, relative to the novice whose possession of these traits would be expected to be limited.

In the context of Study 1, a novice profiler was defined as an individual who has declarative knowledge pertaining to the domain, but with little or no task-oriented experience. By comparison, expert profilers were recruited based on their extensive degree of operational experience in the domain (15 years or more), their supervisory roles, and their professional recognition among peers in the domain.

4.4.2 Stimuli/Measures

Four text-based vignettes depicting criminal-act scenarios and based on real-world case studies (Edwards, 2002; Owen, 2004), were presented to participants (see Appendix A). These
cases were drawn from relatively complex investigations that required the use of profiling
techniques. A digital voice recorder and microphone were used to record participants’ responses.

4.4.3 Procedure

The current study employed a cognitive task analysis strategy based on the CDM (Klein
et al., 1989): The Real-Time CDM. Specifically, the strategy involved the presentation of pre-
selected, non-routine, critical incidents (violent crime scenarios) to both expert and novice
profilers. Participants from both groups (experts and novices) received four criminal-act
vignettes, one case at a time. Following a brief review of each case vignette, participants were
each asked to undertake an interview. During this process, they were asked initially to identify
the acts, forensic findings, and victimology that were of interest to the investigation of the crime
in question (a process consistent with the protocol engaged by the majority of offender profilers
(Hazelwood et al., 1995)). Participants were then asked to think-aloud as they detailed the
features of interest from the scenario. They were also asked to detail the relevance of these
features to the investigation and explain the concepts that came to mind when attending to these
features. Finally, participants were asked to construct a profile of traits consistent with the
unknown offender, based on the information present and their previous knowledge and/or
experience. This interview process utilised a set of semi-structured cognitive probes to elicit
precise descriptions of the cue-based information. The interview protocol is shown in Appendix
B.

Participants were asked to repeat this process for each of the four criminal-act vignettes
that were administered. The interview responses were recorded and transcribed. Microsoft
NVivo Version 7 was used for both the initial content analysis, and the subsequent thematic
analysis.

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1 Ethical considerations preclude the release of the interview transcripts.
4.5 Results

Although there is no single method for analysing interview transcripts, analysis tends to be largely qualitative in nature, generally involving the use of coding techniques (Burnard, 1991). Generally, the coding techniques adopted will reflect the information sought by the user, with the needs of the researcher said to be driving the nature of the analysis (Klein et al., 1989). Study 1 sought to identify an inventory of concept labels representative of the environmental cues of interest to profilers and the associated concepts retrieved from memory. Consistent with this aim, the current analysis involved two stages: 1) a content analysis for the extraction of case-specific crime-related and offender-related feature descriptions; and, 2) a thematic analysis to collapse these case-specific feature descriptions into general concept labels, which may be used in an adapted paired association task to discriminate between expert and novice cue activation (detailed Study 2).

4.5.1 Extraction of Feature Descriptions

The initial stage of the analysis sought two divisions of feature descriptions; those relating to the criminal act (environmental cues), and those relating to the unknown offender (presumably retrieved from memory). This process employed a content analysis of the interview transcripts. Content analysis is a process for the extraction of text data via coding (Hsieh & Shannon, 2005). Generally, two stages of analysis are involved.

The first stage of content analysis involves choosing a unit of analysis. The unit of analysis refers to the basic piece of text that is to be extracted from the transcript (Weber, 1990). In the current work, all interviewee phrases were initially extracted from the transcripts. Content words (nouns, adjectives, and adverbs) were then extracted from these phrases, while function words and full verbs were dismissed (O’Hare et al., 2000; Stanton et al., 2006).
The second stage of content analysis involves classifying these units into a coding scheme (Denzin & Lincoln, 1994). This process is usually based on a model or theory and should involve each scheme being defined as internally homogeneously as possible and as externally heterogeneously as possible (Lincoln & Guba, 1985). In the current study, the coding scheme was based on the practice of offender profiling, whereby, generally, two spheres of information are relevant to the process: 1) information relating to the crime; and, 2) information relating to the offender (Hazelwood et al., 1995). As a result, the current coding scheme involved the classification of units into these two categories, including: 1) Feature descriptions pertaining to the criminal act: Any information pertaining to the act itself, and/or the environment in which the offender interacted during his/her actions. This may include aspects of the scene, the process, forensic findings, and victimology (victim traits) (Hazelwood et al., 1995); and, 2) Feature descriptions pertaining to traits of the offender: Any information that refers to a prominent or conspicuous characteristic of the unknown perpetrator of the criminal-act depicted. This includes any reference to an offender in terms of his or her physical or psychological characteristics or any other description that is of interest to a criminal investigation (Hazelwood et al., 1995). Two coders were used for the classification of feature descriptions into these two categories.

4.5.1.1 Inter-Coder Agreement – Content Analysis

The reliability of the coding outcomes of the content analysis was established by examining the level of inter-coder agreement. Agreement percentage is the most widely used method for assessing inter-coder reliability (Tinsley & Weiss, 1975). Two coders with proficient knowledge of the profiling process and its terminology\(^2\) classified the extracted feature descriptions into three categories: criminal act, offender traits, and miscellaneous. Coders were

\(^2\) Both coders have completed the Behavioural Evidence Analysis seminar (Bond University, Australia) and Behavioural Evidence Analysis course (Forensic Solutions Inc., U.S.A (online), and the Criminology and Profiling course (Sydney University, Australia).
able to classify feature descriptions into any one of these categories, or, both the crime act and
crime act and offender traits categories.

Percentage ratings for agreement were calculated by dividing the number of agreement
occurrences by the number of observations. An agreement rating of 100% was established
between the coders for the classification of feature descriptions into the three categories. This
result demonstrates a high level of inter-coder reliability, as Neuendorf (2002) suggests an
agreement rating of >80% to be sufficient. Although there was a forced-choice element to the
coding process, the high level of surface agreement meant that the potential confound of chance
agreement was considered inconsequential (Banaerjee, Capozzoli, McSweeney, & Sinha, 1999;
Carletta, 1996).

4.5.2 Collapsing Feature Descriptions into Concept Labels

The second stage of the analysis was designed to collapse the feature descriptions into
concept labels that represent the potential cues used by profilers (crime-related concepts) and the
associated concepts (offender-related concepts) that they may retrieve from memory. These
concept labels will be used as a basis for discriminating between expert and novice cue
activation using an adapted paired association task (detailed in Study 2). The notion of concept
labels, which may encompass any number of specific environmental features, was intended to be
broadly consistent with Anderson’s (1993) model of associative memory that posits the idea of
chunks.

A thematic analysis was used to identify a number of conceptual themes into which the
feature descriptions could be collapsed. A thematic analysis can be defined as an exploration of
qualitative data that results in the emergence of themes or concepts that aid in the description or
understanding of a phenomenon (Fereday & Muir-Cochraine, 2006). Crime-related and offender-
related feature descriptions were collapsed into non-directional concept labels that restricted the infinite number of possible values that could exist across a range of concepts. For example, three crime-related feature descriptions: *blitz*, *surprise*, and *con*, could be collapsed into the crime-act-related concept label *method of approach*. Similarly, three feature descriptions relating the offender’s traits: *shy*, *charming*, and *sociable*, could be collapsed into the concept label *social competency*. From this manipulation, it was expected that the observation of crime-related concept labels may be able to cue the retrieval of offender-related concepts (a notion explored in Study 2). For example, the *method of approach* evident in the crime act may cue the profiler to the offender’s degree of *social competency*. The two coders used Microsoft NVivo version 7 to identify the concept labels.

4.5.2.1 Inter-Coder Agreement – Thematic Analysis

The reliability of the outcomes of the thematic analysis was established by examining the level of inter-coder agreement. The same two coders who undertook the initial content analysis performed the thematic analysis. Percentage ratings for agreement were again calculated by dividing the number of agreement occurrences by the total number of observations. An agreement rating of 85% was established between each coder. This result demonstrates satisfactory inter-coder reliability (Neuendorf, 2002). As there was no forced-choice element to the analysis, chance agreement was not an issue (Carletta, 1996). Further, only those concept labels for which there was agreement were extracted.

The analysis yielded a total of 41 crime-related and 28 offender-related concept labels from both the expert and novice groups. The final list of concept labels, and the terminology used to describe them, was rated as highly appropriate/representative of the key areas of interest within criminal profiling by three subject-matter experts. Although the comparison of feature
descriptions across expertise was considered irrelevant (e.g., clever vs. smart), the contribution of each group to the identification of these labels was assessed. Descriptive results revealed that of the 69 concept labels identified, the experts’ feature descriptions contributed, to some extent, to all 69 (100%) labels. In contrast, the novices feature descriptions contributed to 43 of the 69 (62.3%) concept labels; 26/41 (63.4%) crime-related and 17/28 (60.7%) offender-related. This suggests a marked difference in the concepts utilised across expertise. Further, the percentages of participants from each group that contributed to each concept label suggest a greater degree of consistency in the concepts used during profiling amongst the expert group. A complete listing of the crime-related concept labels, a breakdown of each groups’ contribution to each label in relation to the feature descriptions offered (including percentage of participants), and randomly chosen examples of the feature descriptions which contributed to the labels, are provided in Table 4.2.
Table 4.2

The Crime-Related Concept Labels, Contributions, and Feature Description Examples

<table>
<thead>
<tr>
<th>Crime-Related Concept Label</th>
<th>Group Contribution (no. of participants who contributed)</th>
<th>Feature Description Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Expert</td>
<td>Novice</td>
</tr>
<tr>
<td>Crime Classification</td>
<td>✓ 10 (100%)</td>
<td>✓ 9 (90%)</td>
</tr>
<tr>
<td>Deception/Manipulation</td>
<td>✓ 10 (100%)</td>
<td>✓ 8 (80%)</td>
</tr>
<tr>
<td>Degree of Force used</td>
<td>✓ 10 (100%)</td>
<td>✓ 2 (20%)</td>
</tr>
<tr>
<td>Depersonalisation (of victim)</td>
<td>✓ 10 (100%)</td>
<td>× 0 (0%)</td>
</tr>
<tr>
<td>Destruction of evidence</td>
<td>✓ 10 (100%)</td>
<td>✓ 8 (80%)</td>
</tr>
<tr>
<td>Escalation</td>
<td>✓ 8 (80%)</td>
<td>× 0 (0%)</td>
</tr>
<tr>
<td>Evidence of Fantasy</td>
<td>✓ 10 (100%)</td>
<td>✓ 2 (20%)</td>
</tr>
<tr>
<td>Injury Type/Locations</td>
<td>✓ 10 (100%)</td>
<td>✓ 10 (100%)</td>
</tr>
<tr>
<td>Intimate Knowledge (of victim)</td>
<td>✓ 10 (100%)</td>
<td>✓ 6 (60%)</td>
</tr>
<tr>
<td>Level of Organisation</td>
<td>✓ 10 (100%)</td>
<td>✓ 10 (100%)</td>
</tr>
<tr>
<td>Method of Approach</td>
<td>✓ 10 (100%)</td>
<td>✓ 1 (10%)</td>
</tr>
<tr>
<td>Method of Body Concealment</td>
<td>✓ 10 (100%)</td>
<td>✓ 6 (60%)</td>
</tr>
<tr>
<td>Personalisation (of victim)</td>
<td>✓ 8 (80%)</td>
<td>× 0 (0%)</td>
</tr>
<tr>
<td>Point/Method of Entry</td>
<td>✓ 10 (100%)</td>
<td>✓ 2 (20%)</td>
</tr>
<tr>
<td>Positioning of victim body</td>
<td>✓ 10 (100%)</td>
<td>× 0 (0%)</td>
</tr>
<tr>
<td>Removal of Items</td>
<td>✓ 10 (100%)</td>
<td>✓ 2 (20%)</td>
</tr>
<tr>
<td>Rituals/Signature</td>
<td>✓ 10 (100%)</td>
<td>× 0 (0%)</td>
</tr>
<tr>
<td>Serial Acts</td>
<td>✓ 10 (100%)</td>
<td>✓ 9 (90%)</td>
</tr>
<tr>
<td>Staging</td>
<td>✓ 10 (100%)</td>
<td>× 0 (0%)</td>
</tr>
</tbody>
</table>
Table 4.2 continued

*The Crime-Related Concept Labels, Contributions, and Feature Description Examples*

<table>
<thead>
<tr>
<th>Crime-Related Concept Label</th>
<th>Group Contribution (no. of participants who contributed)</th>
<th>Feature Description Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of Sexual/Violent Acts</td>
<td>✓ 8 (80%) × 0 (0%)</td>
<td>post-mortem, anti-mortem</td>
</tr>
<tr>
<td>Torture/Sadistic Behaviours</td>
<td>✓ 10 (100%) ✓ 2 (20%)</td>
<td>torture, sadism, torment</td>
</tr>
<tr>
<td>Transportation of Victim</td>
<td>✓ 10 (100%) ✓ 3 (30%)</td>
<td>transported, drove, picked-up</td>
</tr>
<tr>
<td>Offender Contact (with relations/police/media)</td>
<td>✓ 7 (70%) × 0 (0%)</td>
<td>inquire, taunt, contact</td>
</tr>
<tr>
<td>Use of Restraints/Bondage</td>
<td>✓ 10 (100%) × 0 (0%)</td>
<td>tied, bound, restrained</td>
</tr>
<tr>
<td>Verbal Behaviours</td>
<td>✓ 7 (70%) × 0 (0%)</td>
<td>voice, instructed</td>
</tr>
<tr>
<td>Victim Age</td>
<td>✓ 10 (100%) ✓ 10 (100%)</td>
<td>age, young, older</td>
</tr>
<tr>
<td>Victim Developmental History</td>
<td>✓ 9 (90%) × 0 (0%)</td>
<td>childhood, growing, abused</td>
</tr>
<tr>
<td>Victim Impulsivity</td>
<td>✓ 7 (70%) × 0 (0%)</td>
<td>impulsive, reckless</td>
</tr>
<tr>
<td>Victim Intelligence</td>
<td>✓ 10 (100%) ✓ 10 (100%)</td>
<td>intelligence, clever, smart</td>
</tr>
<tr>
<td>Victim Maintained</td>
<td>✓ 10 (100%) ✓ 4 (40%)</td>
<td>held, captive, locked</td>
</tr>
<tr>
<td>Victim Mental Health</td>
<td>✓ 10 (100%) ✓ 10 (100%)</td>
<td>mental, crazed, nuts</td>
</tr>
<tr>
<td>Victim Personality Variables</td>
<td>✓ 10 (100%) ✓ 7 (70%)</td>
<td>personality, extroverted, introverted</td>
</tr>
<tr>
<td>Victim Race</td>
<td>✓ 10 (100%) ✓ 10 (100%)</td>
<td>Caucasian, white, black</td>
</tr>
<tr>
<td>Victim Resistance</td>
<td>✓ 9 (90%) ✓ 2 (20%)</td>
<td>resisted, fought, fight</td>
</tr>
<tr>
<td>Victim Risk Level</td>
<td>✓ 10 (100%) ✓ 4 (40%)</td>
<td>risk, danger, risky</td>
</tr>
<tr>
<td>Victim Routine</td>
<td>✓ 10 (100%) ✓ 10 (100%)</td>
<td>routine, regular, usual</td>
</tr>
<tr>
<td>Victim Selection</td>
<td>✓ 10 (100%) ✓ 5 (50%)</td>
<td>selected, picked, chosen</td>
</tr>
</tbody>
</table>
### The Crime-Related Concept Labels, Contributions, and Feature Description Examples

<table>
<thead>
<tr>
<th>Crime-Related Concept Label</th>
<th>Group Contribution (no. of participants who contributed)</th>
<th>Feature Description Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victim Self-esteem</td>
<td>✓ 5 (50%) × 0 (0%)</td>
<td>self-esteem, self-confidence</td>
</tr>
<tr>
<td>Victim Similarity</td>
<td>✓ 10 (100%) × 0 (0%)</td>
<td>resembles, similarities, likeness</td>
</tr>
<tr>
<td>Victim Socioeconomic status</td>
<td>✓ 10 (100%) × 0 (0%)</td>
<td>poor, socioeconomic, blue collar</td>
</tr>
<tr>
<td>Window of Opportunity</td>
<td>✓ 10 (100%) ✓ 2 (20%)</td>
<td>opportunity, timing, chance</td>
</tr>
</tbody>
</table>

A complete listing of the offender-related concept labels, a breakdown of each groups’ contribution to each label in relation to the feature descriptions offered (including percentage of participants), and randomly chosen examples of the feature descriptions which contributed to the labels, are provided in Table 4.3.
Table 4.3

The Offender-Related Concept Labels, Contributions, and Feature Description Examples

<table>
<thead>
<tr>
<th>Offender-Related Concept Label</th>
<th>Group Contribution (no. of participants who contributed)</th>
<th>Feature Description Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addictive Behaviours</td>
<td>✓ 8 (80%) × 0 (0%)</td>
<td>addicted, alcoholic, pornography</td>
</tr>
<tr>
<td>Age</td>
<td>✓ 10 (100%) × 10 (100%)</td>
<td>age, young, older</td>
</tr>
<tr>
<td>Anti-Social Behaviours</td>
<td>✓ 8 (80%) × 2 (20%)</td>
<td>anti-social, unfriendly, destructive</td>
</tr>
<tr>
<td>Belief System/World View</td>
<td>✓ 9 (90%) × 3 (30%)</td>
<td>religious, fanatic, extremist</td>
</tr>
<tr>
<td>Build/Body Type</td>
<td>✓ 10 (100%) × 10 (100%)</td>
<td>tall, strong, larger</td>
</tr>
<tr>
<td>Criminal History</td>
<td>✓ 10 (100%) × 10 (100%)</td>
<td>record, criminal, priors</td>
</tr>
<tr>
<td>Criminal Sophistication</td>
<td>✓ 10 (100%) × 0 (0%)</td>
<td>sophistication, style, professional</td>
</tr>
<tr>
<td>Degree of Intelligence</td>
<td>✓ 10 (100%) × 10 (100%)</td>
<td>intelligence, clever, smart</td>
</tr>
<tr>
<td>Developmental History</td>
<td>✓ 9 (90%) × 0 (0%)</td>
<td>childhood, growing, abused</td>
</tr>
<tr>
<td>Employment Type/History</td>
<td>✓ 10 (100%) × 6 (60%)</td>
<td>job, skilled, labour</td>
</tr>
<tr>
<td>Familiarity with location</td>
<td>✓ 10 (100%) × 6 (60%)</td>
<td>local, familiar, unfamiliar</td>
</tr>
<tr>
<td>Gender</td>
<td>✓ 10 (100%) × 10 (100%)</td>
<td>male, he, his</td>
</tr>
<tr>
<td>Interests/Affiliations</td>
<td>✓ 10 (100%) × 0 (0%)</td>
<td>hobbies, hunting, member</td>
</tr>
<tr>
<td>Location of Residence/Work</td>
<td>✓ 10 (100%) × 2 (20%)</td>
<td>home, worksite, residence</td>
</tr>
<tr>
<td>Mental State/History</td>
<td>✓ 10 (100%) × 2 (20%)</td>
<td>mental, crazed, nuts</td>
</tr>
<tr>
<td>Military History</td>
<td>✓ 6 (60%) × 0 (0%)</td>
<td>army, service, military</td>
</tr>
</tbody>
</table>
Table 4.3 continued

The Offender-Related Concept Labels, Contributions, and Feature Description Examples

<table>
<thead>
<tr>
<th>Offender-Related Concept Label</th>
<th>Expert</th>
<th>Novice</th>
<th>Feature Description Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personality Variables</td>
<td>✓ 10 (100%)</td>
<td>✓ 7 (70%)</td>
<td>personality, extroverted, introverted</td>
</tr>
<tr>
<td>Possession of Secure Site</td>
<td>✓ 10 (100%)</td>
<td>× 0 (0%)</td>
<td>basement, workshop, secure</td>
</tr>
<tr>
<td>Post-Event Behaviours</td>
<td>✓ 10 (100%)</td>
<td>× 0 (0%)</td>
<td>absence, leave, stress</td>
</tr>
<tr>
<td>Pre-event Stressors</td>
<td>✓ 10 (100%)</td>
<td>× 0 (0%)</td>
<td>rejection, stressor, fired</td>
</tr>
<tr>
<td>Race</td>
<td>✓ 10 (100%)</td>
<td>✓ 10 (100%)</td>
<td>Caucasian, white, black</td>
</tr>
<tr>
<td>Relationship with Victim</td>
<td>✓ 10 (100%)</td>
<td>✓ 7 (70%)</td>
<td>relationship, related, uncle</td>
</tr>
<tr>
<td>Relationship/Living situation</td>
<td>✓ 10 (100%)</td>
<td>✓ 1 (10%)</td>
<td>marital, single, loner</td>
</tr>
<tr>
<td>Routine/Lifestyle</td>
<td>✓ 10 (100%)</td>
<td>✓ 10 (100%)</td>
<td>routine, regular, usual</td>
</tr>
<tr>
<td>Sexual Competency</td>
<td>✓ 8 (80%)</td>
<td>× 0 (0%)</td>
<td>impotent, dysfunction, incompetent</td>
</tr>
<tr>
<td>Social Competency</td>
<td>✓ 10 (100%)</td>
<td>× 0 (0%)</td>
<td>charming, sociable, friendly</td>
</tr>
<tr>
<td>Socioeconomic Status</td>
<td>✓ 10 (100%)</td>
<td>× 0 (0%)</td>
<td>poor, socioeconomic, blue collar</td>
</tr>
<tr>
<td>Vehicle Type</td>
<td>✓ 5 (50%)</td>
<td>✓ 1 (10%)</td>
<td>truck, van, polished</td>
</tr>
</tbody>
</table>

4.6 DISCUSSION

Study 1 was designed to identify a number of potential cues and their associated concepts that may reside in memory, as used by two classes of profiler; expert and novice. This study had three specific aims: 1) to identify a number of feature descriptions that the profilers may target in
an operational environment (potential cues); 2) to identify a number of feature descriptions relating to an unknown offender, that profilers might retrieve from memory when cued; and, 3) to collapse these two groups of feature descriptions into concept labels which represent the potential environmental cues used (crime-related concept labels) and the associated concepts (offender-related concept labels) retrieved from memory.

The study employed a Cognitive Task Analysis (CTA) strategy based on the Critical Decision Method (CDM) (Klein et al., 1989): the Real-Time CDM. Specifically, the strategy involved the presentation of pre-selected, non-routine, critical incidents (violent crime scenarios) to both expert and novice profilers. The interviewer then asked participants to verbally trace their thought processes when constructing a diagnosis (criminal profile of an unknown offender) and use a set of specially designed cognitive probes designed to elicit information, in real-time, relating to the participants’ cue-use.

The study was successful in yielding a large number of concepts labels via the revised version of the CDM technique (Klein et al., 1989) (i.e., the Real-Time CDM), and subsequent content and thematic analyses. The analysis yielded a total of 41 crime-related and 28 offender-related concept labels from both the expert and novice groups. A comparison of the experts’ and novices’ contributions to these concept labels (in relation to the feature descriptions offered by each group) revealed that the experts’ feature descriptions contributed to a relatively greater number of the concepts identified compared to the novices. This result suggests a marked difference in the concepts utilised by experts and novices during profiling, and that experts may possess a broader network of cue-based concepts in memory. This is consistent with previous research which has found differences in the environmental cues targeted across expertise (Fisher & Pollatsek, 2007; Schriver et al., 2008; Stokes et al., 1992; Wiggins, 2006). Further, the
percentages of participants from each group that contributed to each concept label suggest a greater degree of consistency in the concepts used during profiling amongst the expert group. Nevertheless, the precise nature of each groups’ cue activation (and presumably use), that is, the associations between concepts that may be triggered in memory, and the relative strength and frequency with which the associations are triggered, remains largely unknown, and will be addressed in Study 2.

Study 1 had two notable limitations. Firstly, the interview process used text-based scenarios as the basis for interviewee’s responses. By not representing some information as it may be found naturally in the operational environment, the use of text-based scenarios may have limited the ecological validity of the current findings. At its extreme, this limitation may misrepresent some forms of cue-based information resulting in misdiagnosis. This is of particular concern for those individuals who may have a preference for visual/spatial information (Kampwirth & Bates, 1980).

Although the use of text-based stimuli is asserted here as a limitation, it should also be noted that the nature of the profiling process requires the conceptualisation of numerous abstract concepts, such as the victim’s intelligence, which would be difficult to represent to the interviewee in a way that reflects the profiler’s natural operations. As a result, the critical incidents were presented in a standardised format, which was consistent with the verbal accounts/descriptions observed within the interview process. This ensured that all of the relevant information could be included and that any potential effect of varying the presentation medium was minimised. Future studies may seek to explore alternative representations of critical incidents to determine whether information presentation impacts interviewee responses.
An alternative solution to this limitation would be to observe decision-makers during real-world operations. For example, researchers have examined naturalistic operations in numerous domains: fire-ground commanders (Klein et al., 1989); naval operators (Driskell et al., 1994); nurses (Shanteau, 1991), etc. Unfortunately, the sensitive nature of the context adopted in the current work made such a design implausible. Further, ethical considerations limited the nature of the stimuli that could be presented to those individuals with limited experience with the subject-matter. Future studies may seek to address these issues by employing virtual reality simulations (Cyril, Romain, Gilles, Pierre, & Jaqcues, 2009) and/or eye-tracking techniques (Seagull & Xiao, 2001) as more ecologically valid means for identifying features of interest, and/or using a context which is more conducive to the use of graphic representations for novices.

A second limitation of the study was the use of a qualitative method. Although the use of qualitative techniques is prominent within naturalistic decision-making research (Klein, 2008), a commonly cited limitation of these techniques is the degree of subjective judgement required on the part of the coder. Nevertheless, the potential for this confound can be greatly reduced through the use of multiple coders and a test of inter-coder reliability (Banerjee et al., 1999). Further, it should be noted that, in the current work, the researcher did not make an attempt to identify or make judgement in regard to the precise nature of the associations that may exist between concepts. Instead, the intention was merely to identify a number of potential concepts commonly engaged during the profiling process. The identification of associations between these potential concepts will be approached in more controlled and objective manner, using an adapted paired association task (detailed in Study 2).
4.6.1 Conclusion

Previous studies observing the naturalistic decision-making process have identified the existence of cues within many decision-making contexts, including fire-fighting (Klein et al., 1986), medical diagnoses (Hammond et al., 1989), courtroom judgments (Ebbesen & Konecni, 1975), aviation (Stokes et al., 1992), chess (de Groot, 1966), finance (Hershey et al., 1990), driving (Fisher & Pollatsek, 2007), and nursing (Shanteau, 1991). Similarly, the current findings support the assertion that profilers actively seek environmental features to cue the recall of potential offender traits from memory. Although these findings suggest that profilers, as decision-makers, indeed use cues, and that there may be differences in the cues used by experts and novices, the findings do not inform the researcher as to the cue-based associations that may reside in memory, nor do they offer insight as to whether such associations differ as a function of expertise. Thus, the precise information that should be included in a cue-based training program remains unclear. These issues shall be addressed in Study 2.

4.7 Chapter Five Brief

Chapter Five will feature Study 2 which incorporated the concept labels identified in an adapted paired association task, used as a basis for discriminating between expert and novice cue activation.
CHAPTER 5

STUDY 2: MEASURING CONCEPTUAL ASSOCIATIVE STRENGTH AS A MEANS OF DISTINGUISHING CUE ACTIVATION ACROSS EXPERTISE, VALIDATING QUALITATIVE OUTCOMES, AND IDENTIFYING AN INVENTORY OF EXPERT PROFILING CUE-BASED ASSOCIATIONS
“It is of the highest importance in the art of detection to be able to recognize, out of a number of facts, which are incidental and which vital. Otherwise your energy and attention must be dissipated instead of being concentrated.”

- Sherlock Holmes, in “The Reigate Squires”
5.1 STUDY OBJECTIVE

Study 2 was designed to discriminate between expert and novice cue activation in the context of offender profiling, using an adapted paired association task. Two phases of study are reported, the first of which (Study 2a) involved presenting pairs of concept labels (identified in Study 1) as part of a Paired-Concept Association Task (P-CAT) which recorded participants’ response latency in recognising/activating associations. This task was designed to measure objectively the relative strength of associations between cues and the concepts that may be retrieved from memory, across expertise level. It was expected that this study would lead to the identification of the strongest expert cue-based associations, which could be used within a cue-based training program (detailed in Study 3). The second phase (Study 2b) involved the distribution of a survey to further test participants’ perceptions of the associations between concepts. The survey was used to explore the basis of the expected differences in response latency observed in Study 2a by examining expert and novice perceptions of the frequency of use, strength, domain specificity, and diagnosticity, of a number of associations recognised by each respective group (expert and novice). This investigation will seek further support for the use of P-CAT as a process for validating the outcomes of interview techniques such as the Critical Decision Method (Klein et al., 1989), and identifying expert cue-based associations.

5.2 STUDY 2A: DISTINGUISHING NOVICE AND EXPERT CUE ACTIVATION BY MEASURING CONCEPTUAL ASSOCIATIVE STRENGTH ACROSS EXPERTISE

5.2.1 Background/Rationale

A number of different methodologies have been developed to elicit cue-based information from subject-matter experts. Although a limited number of studies have sought to identify expert cues using on-line tasks such as eye-tracking (Seagull & Xiao, 2001), the vast
majority of studies (including Study 1 of this thesis) have used off-line, qualitative techniques, in which cues are extracted through a subjective coding process (Crandall et al., 2006; Crandall & Getchell-Reiter, 1993; Klein et al., 1989; O’Hare et al., 2000). This is generally due to the fact that, unlike more experimentally controlled techniques, such as eye-tracking, interviewing techniques provide greater insight into a range of cues across perceptual domains, and, further, provide insight into the concepts that are not physically evident in the operational environment, but instead, are resident in memory (Beatty & Willis, 2007). Nevertheless, two criticisms associated with qualitative forms of elicitation are outlined.

Firstly, there is concern in relation to the extent to which the outcomes of qualitative techniques are both reliable and valid. For example, in the case of retrospective verbal protocol analysis, there has been some concern as to whether the outcomes of this process reflect a rationalisation of behaviour, rather than an accurate reflection of the cues that were engaged during the process (Kusela & Paul, 2000). This has several implications for the success of cue-based training and support systems, the most significant of which is the potential selection of ineffective and/or inappropriate cues that may, ultimately, result in deterioration in performance (Wiggins, 2006). As a result, there is a need for a method that will validate the information extracted using qualitative techniques, as valid and reliable markers of the underlying cognitive processes that are engaged during the performance of the task. While there have been some attempts to validate cues extracted through interview, these have been restricted largely to the administration of surveys in which participants indicate independently their application of particular cues (Wiggins, 2007).

A second criticism levelled at current elicitation processes is the extent, to which the outcomes, namely expert cue inventories, are a true reflection of the knowledge that
differentiates expert and non-expert cue activation. Indeed, as knowledge elicitation strategies are largely retrospective in nature (Crandall & Getchell-Reiter, 1993), the application of these techniques in non-expert samples is generally not feasible because, as the novices’ limited operational experience will presumably impede their capacity to generate useful incidents for deliberation. Although Study 1 incorporated a revised version of the Critical Decision Method (Real-Time CDM) that allowed for an investigation of novice cue-use, the technique provided little insight into the precise differences in cue activation (and presumably use) across expertise, which may inform system designers of the key information that will advance the cognitive skills of the non-expert.

Considering these two criticisms, the current study sought to test a method that objectively discriminates between expert and novice cue activation to ensure that the outcomes embedded in training and support initiatives are valid and reliable markers of the information that distinguishes expert from novice operations: The author proposes the measurement of relative conceptual associative strength as a means for discriminating expert and novice cue activation.

5.2.1.1 Conceptual Associative Strength

Effective cue use allows a decision-maker to simplify a complex array of stimuli, ensuring that irrelevant information does not occupy his or her limited information processing resources during decision-making (Wickens & Hollands, 2000). Indeed, the value of cues in information processing lies partly in their capacity to obviate the requirement for extensive working memory resources to initiate a response (Wiggins, 2006). This rapid response between the recognition of a concept and its association with another concept residing in memory is based on their previous co-occurrence in working memory (Gillund & Shiffrin, 1984).
Concepts that co-occur more often become more strongly associated, resulting in a greater capacity to retrieve related concepts from memory (Anderson, 1993). The relative efficiency with which this process occurs is dependent upon two characteristics: (a) The specificity of the relationship between the concepts; and (b) the strength of the association between the concepts (Anderson, 1983).

With limited experience in a domain, operators may be unable to activate a specific association quickly. However, with increasing interaction with the environment, the repeated exposure and successful application of an association will increase the likelihood that the association will be recognised quickly and accurately (Anderson, 1993; McNamara 1994).

Indeed, it might be argued that both the recollection and the strengthening of cue-based associations are dependent on an individual’s capacity to activate the relevant pathways to the information stored in memory (Eveleth, 1999). Through active engagement in a task, the number of pathways between cues and their associated concepts presumably increases, resulting in multiple paths of activation (Collins & Loftus, 1975). In concert with increases in the strength of activation, these multiple pathways contribute to more rapid cue activation and anticipation, even during what might be regarded as complex scenarios. Moreover, multiple pathways are associated with improvements in the accuracy of responses, since particular cues are better associated with particular concepts in memory than others (Eveleth, 1999).

Following these assertions, it might be argued that the consistency and speed with which conceptual relationships are recognised reflects the activation of underlying associations that are resident within memory. Therefore, a relationship might be proposed between an association’s relative strength in memory and the speed and consistency with which it is recognised.
Support for this perspective can be drawn from the use of paired association tasks, which infer the strength of associations in memory based on response latency (Meyer & Schvaneveldt, 1971). In most cases, these paired association methodologies employ the use of a prime stimulus that is followed shortly thereafter by a target stimulus (McNamara, 1992). Priming occurs when the presentation of one item (a prime) (e.g., sky) accelerates the response to a succeeding, related item (a target) (e.g., blue) (McNamara, 1994). The response latency to the target is used to examine participants’ capacity to recognise associations between the prime and the target stimulus. For example, Meyer and Schvaneveldt (1971) used a Lexical Decision Task (LDT) to examine the potential link between the recognition of meaningful relationships and response latency. The LDT presents participants with words (e.g., cat) and pseudo words (e.g., blar), and asks them to determine, as quickly as possible, whether or not the item presented is a valid word (Neely, et al., 1989). Meyer and Schvaneveldt presented items in pairs to examine the potential effects of priming on participants’ recognition of related and unrelated pairs. They demonstrated that response latency to the second item was shortest when it was a word, and when the first item in the pair was a word that was semantically related. Thus, the response latency to targets preceded by related versus unrelated primes can be used to test for associations in memory.

Given the utility of paired association methodologies for enabling the classification of associations in memory, the present study adopted a similar approach, referred to as the Paired-Concept Association Task\(^1\) (P-CAT) (designed and developed in-house). The P-CAT involves the brief presentation of a concept label at the centre of a computer screen. This is then replaced by a screen with the same concept label presented on the left-hand side and a different concept description on the right-hand side. During each presentation, participants are asked to indicate

\(^1\) Formerly known as the Feature Event Paired Association task, FEPAT (Morrison, Wiggins, Bond, & Tyler, 2009).
whether the concepts presented share an association by responding either Yes or No, as quickly as possible, using the computer keyboard.

In the P-CAT, the initial concept label, presented prior to the pairing, acts as the prime or cue. Here, the processing of the initial concept label is expected to cue the user to a limited number of potentially related concepts in memory, thereby promoting an accelerated rate of recognition if a valid association between the two subsequently presented concepts is present in memory.

The current study used the 41 crime-related and 28 offender-related concept labels identified in Study 1 as the stimuli within the P-CAT to test the cue-based associations that may be recognised/activated by expert and novice profilers. As profilers generally familiarise themselves with the crime (i.e., the crime-related concepts evident in a given scenario) and subsequently formulate connections with the unknown offender (i.e., offender-related concepts), the ordering of the concept label pairings presented in the P-CAT reflected this process (i.e., crime ➔ offender). For example, the crime-related concept label method of approach may be paired with the offender-related concept label social competency. Thus, the crime-related concept label, which generally represents the environmental cue, will act as the initial prime stimulus, and response latency will be recorded from the point of the target stimulus (i.e., the offender-related concept label) presentation. Each crime-related concept label will be paired randomly with each offender-related concept.

5.2.2 Aim

The aim of Study 2a is to test for differences in cue activation across expert and novice profilers using the P-CAT. Specifically, the P-CAT was intended to distinguish between expert and novice cue activation in terms of: (1) the level of consistency with which concepts are
associated within groups; (2) the types of concept relations that are perceived to be most related; and (3) the response latency in responding to concept pairings. In doing so, it was anticipated that the findings will yield a number of cue-based associations which are predominantly used by expert decision-makers that may be embedded in a cue-based training system.

Several predictions were made regarding these findings. Specifically, when presented with concept pairings in controlled conditions, the researcher hypothesised: 1) greater agreement among experts than novices concerning the associations recognised; 2) low agreement between experts and novices concerning the associations recognised; and, 3) shorter response latencies for experts than novices for the associations activated by the experts.

5.2.3 Method

5.2.3.1 Design

Study 2a employed a between-subjects design with a single Independent Variable (IV), expertise, comprising two levels: expert and novice. The Dependent Variables (DV) were: 1) participants’ classification of the associations as valid or invalid (Yes or No responses); 2) the level of classification agreement amongst and between each group; 3) the composition of the associations recognised/activated; and, 4) participants’ response latency in relation to their classifications.

5.2.3.2 Participants

Eight experts (eight male, mean age = 47.2 years) who participated in Study 1, and 20 novice participants (12 male and eight female, mean age = 23.1 years) (including 10 who participated in Study 1), participated in Study 2a. The recruitment/selection of the additional 10 novices was consistent with the classification of *novice* used in Study 1.
5.2.3.3 Stimuli/Apparatus

The 41 crime-related and 28 offender-related profiling concept labels identified in Study 1 were presented to participants as part of the P-CAT. Association classifications and response latencies (from the point of paired presentation onset) were recorded for each of the concept pairs presented.

The P-CAT was presented to participants on a laptop computer (LG, 17” colour monitor, ATi Mobility X1400, 1GB DDR2 667 MHz RAM) using DMDX software (Forster & Forster, 2003), which recorded both the classification ratings and the response latencies. The P-CAT script for use in DMDX is provided in Appendix C (specific concept label combinations were counterbalanced). The same laptop was used for all participants to maintain a consistent screen refresh rate of 16.46ms. Two markers were posted at the top of the computer screen differentiating the crime-related concept label (left of screen) from the offender-related concept label (right of screen) to assist the orientation of participants. The right shift key was labelled Yes and the left shift key was labelled No. An illustration of the P-CAT set-up on a laptop computer terminal is shown in Figure 5.1.
5.2.3.4 Procedure

The participants were seated in front of the laptop computer. Prior to the test trials they completed 12 familiarisation trials, each consisting of a single concept pairing. Familiarisation trials consisted of several associations that were based on assumed common knowledge (e.g., *sky + blue*). Several incongruent pairs were also used (e.g., *sky + crocodile*). However, no context-relevant exemplar pairs were provided to avoid exposure bias (see Appendix D for complete listing of familiarisation trials). Prior to commencing the test trials, participants were provided with the list of profiling-related concept labels (identified in Study 1) to ensure that they were familiar with the terminology used.
Preliminary investigations were conducted to determine suitable presentation durations and intervals and to ensure that concept label length did not impact comprehension (see Appendix E). The initial crime-related prime had the longest duration to promote the activation of a number of potential associations in participants’ memory. For each test trial, participants were briefly presented with a crime-related concept label at the centre of the screen for 3292 ms. Subsequently (after a time interval of 1646ms), this screen was replaced with the presentation of the same concept label on the left side of screen simultaneously with an offender-related concept description presented on the right of screen for 1646ms. The next trial commenced after a time interval of 1646ms. Participants’ responses were timed-out after an interval of 1394ms (i.e., if no response was made, a response latency of 1394ms was recorded). An example of the sequence of one P-CAT trial is illustrated in Figure 5.2.

Figure 5.2. An example of the sequence of screen presentations within the P-CAT.
For each presentation, participants were instructed to decide whether each pairing was associated by striking either the right (Yes) or left (No) shift keys on the computer provided, as quickly as possible. The test phase consisted of a total of 1148 trials created from the exhaustive pair-wise combination of 41 crime-related and 28 offender-related concepts from Study 1. They were separated into three blocks of 280 trials and one of 308 trials that constituted the combination of 10 or 11 crime-related concept labels paired with 28 offender-related concept labels, comprising a total of 1148 trials in each experimental session. Participants were given the opportunity to rest between blocks, if desired. Each concept pairing presentation within each block, and each block itself, was counterbalanced to control for practice effects.

5.2.4 Results

5.2.4.1 Data Reduction

Participant association classifications and response latencies (from the point of paired presentation onset), were recorded for each concept pairing presented. Due to the large number of pairings (1148), many of which were rejected by both experts and novices, it was considered prudent to exclude some of the response data from subsequent analysis on the basis of agreement and response latency. In the case of agreement, pairs were ranked separately in order of consistency as to whether there was an association between two concepts. The leading 20% of pairs from each group (n = 230) were selected for subsequent comparison. Consistent with the data pertaining to agreement, the 230 pairs were then ranked-ordered on the basis of mean response latency. The shortest 20% (46) of response latencies were retained. These 46 concept pairs from each group were termed the expert and novice target samples and were subject to analysis. A complete listing of the expert and novice target samples is provided in Appendix F. To aid conceptualisation, the top five associations from each target sample (expert and novice)
are provided in Table 5.1. Further, a concept map of the associations between crime-related concepts and the offender-related concepts, as evident in the expert target sample, is shown in Figure 5.3.

Table 5.1.

The Top Five Cue-Based Associations from each Target Sample (Expert and Novice), Based on Agreement and Response Latency

<table>
<thead>
<tr>
<th>No.</th>
<th>Expert Target Sample</th>
<th>Novice Target Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Concept Label (crime-related)</td>
<td>Concept Label (offender-related)</td>
</tr>
<tr>
<td>1</td>
<td>Destruction of Evidence</td>
<td>Criminal Sophistication</td>
</tr>
<tr>
<td>2</td>
<td>Method of Body Concealment</td>
<td>Degree of Intelligence</td>
</tr>
<tr>
<td>3</td>
<td>Method of Approach</td>
<td>Social Competency</td>
</tr>
<tr>
<td>4</td>
<td>Injury Type/Location</td>
<td>Relationship with Victim</td>
</tr>
<tr>
<td>5</td>
<td>Staging</td>
<td>Degree of Intelligence</td>
</tr>
</tbody>
</table>

5.2.4.2 Analyses

The aim of the analyses was to determine whether differences in cue activation (and presumably use) existed across the two groups of profilers: expert and novice. Specifically, two potential differences in activation across expertise were investigated: 1) differences in the degree of agreement amongst the expert and novice groups in relation to associations and their individual concepts; and, 2) differences in response latency across the expert and novice groups.
Figure 5.3. A concept map of the associations between crime-related and offender-related concepts, as evident in the expert target sample.
Association Agreement. The aim of the association agreement analysis was to determine the level of agreement for associations amongst and across both groups. Firstly, in relation to association agreement amongst each group, a frequency analysis revealed that agreement ranged from 87.5 to 100% among the expert sample compared within 75 to 100% in the novice target sample; demonstrating a relatively greater degree of agreement amongst experts in relation to which concept pairings represented valid associations.

Secondly, in relation to potential differences in associations across each group, a one-way chi-square was used to test whether a difference existed between the expected and observed frequencies for the number of expert associations recognised by the novices. The chi-square analysis revealed a statistically significant difference, \( \chi^2 (1, N = 52) = 30.80, p < .001 \). These results indicate that a less than expected proportion of expert associations appeared in the novice target sample. Indeed, of the 46 concept pairings from the expert target sample, only six (13%) occupy a position within the novice target sample. In relation to the individual concepts (crime-related and offender-related) that comprise the associations, the novice target sample only contained 16 (64%) of the experts’ 25 crime-related concepts, and only five (45%) of the experts’ 11 offender-related concepts. Overall, these results demonstrate a potential difference in cue-use across expertise, based on the associations which may be activated within the operational environment. A comparison of the crime-related concepts evident in each target sample is provided in Table 5.2.
Table 5.2

*A Comparison of the Crime-related Concepts Evident in Each Target Sample. The Number of Occurrences is in Parentheses*

<table>
<thead>
<tr>
<th>Crime-Related Concepts</th>
<th>Expert Target Sample</th>
<th>Novice Target Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point/Method of Entry (5)</td>
<td></td>
<td>Victim Similarity (4)</td>
</tr>
<tr>
<td>Method of Body Concealment (4)</td>
<td></td>
<td>Victim Risk Level (4)</td>
</tr>
<tr>
<td>Torture/Sadistic Behaviour (4)</td>
<td></td>
<td>Victim Risk Level (3)</td>
</tr>
<tr>
<td>Evidence of Fantasy (3)</td>
<td></td>
<td>Victim Maintained (3)</td>
</tr>
<tr>
<td>Staging (3)</td>
<td></td>
<td>Torture/Sadistic Behaviour (3)</td>
</tr>
<tr>
<td>Method of Approach (3)</td>
<td></td>
<td>Escalation (3)</td>
</tr>
<tr>
<td>Deception/Manipulation (3)</td>
<td></td>
<td>Level of Organisation (3)</td>
</tr>
<tr>
<td>Transportation of Victim (2)</td>
<td></td>
<td>Degree of Force Used (3)</td>
</tr>
<tr>
<td>Degree of Force Used (2)</td>
<td></td>
<td>Victim Selection (2)</td>
</tr>
<tr>
<td>Victim Selection (2)</td>
<td></td>
<td>Deception/Manipulation (2)</td>
</tr>
<tr>
<td>Window of Opportunity (2)</td>
<td></td>
<td>Intimate Knowledge (of Victim) (2)</td>
</tr>
<tr>
<td>Positioning of Victim (1)</td>
<td></td>
<td>Method of Body Concealment (2)</td>
</tr>
<tr>
<td>Serial Acts (1)</td>
<td></td>
<td>Depersonalisation (of Victim) (2)</td>
</tr>
<tr>
<td>Depersonalisation (of Victim) (1)</td>
<td></td>
<td>Victim Impulsivity (2)</td>
</tr>
<tr>
<td>Use of Restraints/Bondage (1)</td>
<td></td>
<td>Rituals/Signature (2)</td>
</tr>
<tr>
<td>Destruction of Evidence (1)</td>
<td></td>
<td>Window of Opportunity (1)</td>
</tr>
<tr>
<td>Level of Organisation (1)</td>
<td></td>
<td>Destruction of Evidence (1)</td>
</tr>
</tbody>
</table>
Table 5.2 continued

*A Comparison of the Crime-related Concepts Evident in Each Target Sample. The Number of Occurrences is in Parentheses*

<table>
<thead>
<tr>
<th>Crime-related Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert Target Sample</td>
</tr>
<tr>
<td>Novice Target Sample</td>
</tr>
<tr>
<td>Injury Type/Location (1)</td>
</tr>
<tr>
<td>Use of Restraints/Bondage (1)</td>
</tr>
<tr>
<td>Victim Mental State (1)</td>
</tr>
<tr>
<td>Method of Approach (1)</td>
</tr>
<tr>
<td>Intimate Knowledge (of Victim) (1)</td>
</tr>
<tr>
<td>Victim Mental State (1)</td>
</tr>
<tr>
<td>Victim Maintained (1)</td>
</tr>
<tr>
<td>Victim Age (1)</td>
</tr>
<tr>
<td>Rituals/Signature Behaviours (1)</td>
</tr>
<tr>
<td>Victim Risk Level (1)</td>
</tr>
</tbody>
</table>

UNSUB Contact (*with Relations/Media/Authority*) (1)

A comparison of the crime-related concepts evident in each target sample is provided in Table 5.3.
### Table 5.3

**A Comparison of the Offender-related Concepts Evident in Each Target Sample. The Number of Occurrences is in Parentheses.**

<table>
<thead>
<tr>
<th>Offender-related Concepts within each Target Sample</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expert Sample (no. of occurrences)</strong></td>
<td><strong>Novice Sample (no. of occurrences)</strong></td>
</tr>
<tr>
<td>Relationship with Victim (9)</td>
<td>Relationship with Victim (10)</td>
</tr>
<tr>
<td>Degree of Intelligence (8)</td>
<td>Criminal History (8)</td>
</tr>
<tr>
<td>Criminal Sophistication (6)</td>
<td>Degree of Intelligence (6)</td>
</tr>
<tr>
<td>Pre-Event Stressors (3)</td>
<td>Criminal Sophistication (5)</td>
</tr>
<tr>
<td>Addictive Behaviours (3)</td>
<td>Mental State/History (4)</td>
</tr>
<tr>
<td>Familiarity with Location (4)</td>
<td>Military History (3)</td>
</tr>
<tr>
<td>Post-Event Behaviour (4)</td>
<td>Gender (2)</td>
</tr>
<tr>
<td>Social Competency (3)</td>
<td>Sexual Competency (2)</td>
</tr>
<tr>
<td>Personality Variables (2)</td>
<td>Addictive Behaviours (2)</td>
</tr>
<tr>
<td>Location of Residence/Work (1)</td>
<td>Pre-Event Stressors (1)</td>
</tr>
<tr>
<td>Possession of Secure Site (1)</td>
<td>Build/Body type (1)</td>
</tr>
<tr>
<td></td>
<td>Anti-Social Behaviour (1)</td>
</tr>
<tr>
<td></td>
<td>Social Competency (1)</td>
</tr>
</tbody>
</table>

*Association Response Latency.* The aim of the response latency analysis was to determine whether a difference existed in the response latency for association recognition (cue activation) across expertise. The analysis employed the expert target sample as an anchor against which novice response latencies for the same concept pairings were compared.
In determining whether a difference existed in expert and novice response latency for the expert target sample, descriptive statistics for both groups’ response latencies revealed definitive and consistent differences across the two groups across all 46 concept pairings from the expert target sample. The mean response latency for experts and novices for the pairings from the expert target sample are presented in Figure 5.4.

As the differences across the groups appeared largely consistent, it was considered unnecessary to employ a statistical test to examine whether significant differences existed for each of the 46 variables and further, that such tests would unnecessarily increase the potential for a Type I error. Instead, participant scores for each of the 46 associations were collapsed into a grand mean for the entire expert target sample. These grand means were then compared across expertise.

A dependent samples $t$-test was employed to determine whether a significant difference existed between experts’ and novices’ response latencies for the expert target sample. Screening of the data revealed 24 outliers (seven within the expert scores and 17 within the novice scores). The outliers were converted to the next extreme score, plus one (Tabachnick & Fidell, 2005). With alpha set at .05, and assumptions of normality met, the results revealed a statistically significant difference between the experts’ and novices’ response latency scores, $t(26) = 5.03, p < .001$. The mean expert response latency for the expert target sample ($M = 611.78, SD = 17.05$) was significantly shorter than the novices’ response latency ($M = 1069.61, SD = 115.33$) for the expert target sample.
**Figure 5.4.** The mean response latency (+SE) for experts and novices for the pairings from the expert target sample.
Although comparisons between response latency across specific associations from the expert target sample were deemed unnecessary, a final dependent sample \( t \)-test was employed to determine whether a significant difference existed between experts’ and novices’ response latencies for the association that showed the least variation across expertise; association number 35 (Method of Body Concealment \( \rightarrow \) Familiarity with Location). With alpha set at .05, and assumptions of normality met, the results revealed a statistically significant difference between the experts’ and novices’ response latency scores, \( t(26) = 10.50, p < .001 \). The mean expert response latency for the association number 35, \( (M = 637.21, SD = 17.05) \) was significantly shorter than the novices’ mean response latency \( (M = 803.04, SD = 115.33) \); a result suggestive of significant differences in response latency across expertise, for each of the 46 associations.

In combination with the previous results, these findings suggest that, not only do experts and novices differ in terms of the types of cue-based associations in their respective samples, but that their response latency in recognising associations also differs, with experts responding much faster than novices to associations from the expert target sample.

5.2.5 Discussion

The aim of Study 2a was to test for differences in cue activation (and presumably use) across expertise using a Paired-Concept Association Task (P-CAT). Specifically, the P-CAT distinguished between expert and novice cue activation in terms of: (1) the level of consistency with which concepts are associated within groups; (2) the types of concept relations that are perceived to be most related; and (3) the response latency in responding to concept pairings. More specifically, two potential differences in activation across expertise were investigated: 1) differences in the degree of agreement amongst the expert and novice groups in relation to
associations and their individual concepts; and, 2) differences in response latency across the expert and novice groups.

5.2.5.1 Association Agreement

In relation to association agreement, the researcher hypothesised greater agreement among experts than novices concerning the associations recognised and, low agreement between experts and novices concerning the associations recognised. The results support the hypotheses concerning agreement, demonstrating that the expert group were, as a whole, more consistent in their classification of associations. This finding supports the assertion that expertise is, in part, based on a decision-maker’s ability to discriminate between stimuli consistently (Shanteau, 1992a; Weiss & Shanteau, 2003). This capacity enables experts to discriminate between cues, presumably resulting in the strengthening of useful associations. This is an interesting finding given the apparent difference in profiling philosophies evident in the participant sample. This suggests that the operational context and the practice of profiling itself may moderate cue-use, rather than factors such as learning backgrounds.

The findings also revealed a low level of agreement across expertise concerning the crime-related concepts (cues) evident in each target sample. This suggests a potential difference across expertise in regard to the cues targeted in the operational environment. This finding is supported by: Stokes et al. (1992) who found that expert pilots were able to identify more relevant cues, and less irrelevant cues, compared to novices; Wiggins & O’Hare (2003) who revealed that expert pilots use more relevant cues when making weather-related decisions; Schriver et al. (2008) who found that more attention was allocated to relevant cues (measured by dwell time in eye-tracking) among experts; and, Morrow et al. (2009) who demonstrated that expert pilots spend more time reading relevant information in decision scenarios than novices.
The fact that novices and experts also differed in regard to the offender-related concepts retrieved from memory, highlights not only a potential difference in the targeting of cues in the environment, but also their interpretation.

5.2.5.2 Association Response Latency

In relation to association response latency, the researcher hypothesised shorter response latencies for experts than novices for the associations activated by the experts. The results supported this hypothesis, revealing that experts’ response latencies were significantly shorter than novices’ response latencies for the expert target sample. On the basis of these results, it can be concluded that cue activation (and presumably use) differs between expert and novice profilers in regard to the cue-based associations recognised and the speed of recognition, and that the P-CAT successfully distinguishes between expert and novice’ assessment of concept relations.

5.2.5.3 Limitations

As in Study 1, the primary limitation associated with the current study was the use of text-based labels to represent concepts. Of course, within any environment, a decision-maker will most likely use an array of information media. For instance, a profiler will both scan a scene for visual evidence such as blood spatter, and for the same case, listen to witness statements (Hazelwood et al., 1995) - a combination of auditory and visual information. The current use of text within the P-CAT may have limited the realism of the cues presented, as many were not presented as they would be found within the operational environment. At its extreme, this limitation may misrepresent some forms of cue-based information resulting in misdiagnosis. However, it should be noted that numerous concepts identified in Study 1 did not allow for a more naturalistic presentation, as many were more abstract concepts (e.g., the offender’s social
competency). As such, the concepts were presented in a standardised format which was consistent with the verbal accounts/descriptions observed within the interview process in Study 1. This ensured that all of the relevant information could be included and that any potential effect of varying the presentation medium was minimised. Future studies may seek to explore the use and comparison of different representations of cue-based information in the P-CAT to determine whether information presentation bares a significant effect on recognition.

A further limitation exists in regard to the proposed use of P-CAT as a tool for identifying cues and their associations. Although it would appear that the P-CAT was able to distinguish between expert and novice cue activation in relation to the type of cue-based information and the speed at which recognition occurs, the findings of Study 2a do not establish the relative value of these associations in the operational environment. Consequently, it is important to further investigate the implied relationship between association strength and perceived association validity within the operational environment. Such an investigation will provide further support for the use of P-CAT as a process for validating the outcomes of interview techniques and identifying expert cue-based associations. The aim of Study 2b was to examine expert and novice perceptions of a selection of associations extracted from each of the target samples (expert and novice) identified in Study 2a with regard to their perceived frequency of use, strength, domain specificity, and diagnosticity.

5.2.5.4 Conclusion

Study 2a was designed to use the P-CAT to distinguish between expert and novice cue activation in terms of: (1) the level of consistency with which concepts are associated within groups; (2) the types of concept relations that are perceived to be most related; and (3) the response latency in responding to concept pairings. Overall, the findings suggest that key
differences in cue activation (and presumably use) exist as a function of one’s level of expertise and that these differences may be distinguished by measuring conceptual associative strength using a response latency-based task such as the P-CAT. Further, the relative consistency and speed with which participants responded to the concept labels suggests that the concepts identified were indeed valid and reliable markers of the concepts engaged during profiling. This suggests that the P-CAT may be used to validate the outcomes of qualitative-based knowledge elicitation techniques, such as the Critical Decision Method (Klein et al., 1989).

5.3 STUDY 2B: PARTICIPANTS’ PERCEPTIONS OF CUE-BASED ASSOCIATIONS FROM THE EXPERT AND NOVICE TARGET SAMPLES

5.3.1 Background/Rationale

In Study 2a, differences in response latency were demonstrated across a range of cue-based associations. It was concluded that these differences represented an indication of relative conceptual associative strength in decision-makers’ long-term memory. The rate at which an association was recognised/activated (as indicated via the P-CAT) was most likely dependent on a number of factors relating to the user’s previous interactions with the association. As such, the aim of Study 2b is to investigate expert and novice perceptions of a selection of associations extracted from each of the target samples identified in Study 2a (expert and novice). More specifically, Study 2b will involve the investigation of four areas of interest from the literature relating to cue-use and decision performance. These areas of interest are detailed below, along with several predictions and research questions.

5.3.1.1 Perceived Frequency of Association Use

The repeated exposure and successful application of an association increases the likelihood that it will be activated in the future (Anderson, 1993). Here, the strength of an
association is predominantly determined by the number of its successful applications previously; its frequency of use (Eveleth, 1999; Lord & Maher, 1990).

Hypothesis (1): It is proposed that a relationship exists between the speed at which an association is retrieved and its perceived frequency of use. Participant perceptions of activation frequency will be compared across both the expert and novice sample of cues to determine whether each group (expert and novice) reports using their respective sample at a greater level of frequency. Specifically, it is hypothesised that participants will report a greater frequency of use for associations which originated from their respective target sample.

5.3.1.2 Perceived Strength

It is presumed that decision-makers will tend to use associations that they perceive as valid (i.e., a strong association between concepts) more frequently than associations that are perceived as less valid (Schriver et al., 2008).

Hypothesis (2): It is hypothesised that participants will report a greater level of perceived strength for cue-based associations drawn from their respective target samples.

5.3.1.3 Perceived Domain Specificity

As the establishment of cue-based associations appears to be dependent upon the level of previous exposure one has to them, it is likely that, in highly specialised operational environments, a significant number of associations will exist that are specific to that domain. For example, a footballer is generally not skilled in neurosurgery, just as a neurosurgeon is generally not skilled in playing football. Only through experience in neurosurgery is the footballer able to acquire meaningful associations involved in successful neurosurgery. Therefore, it is logical to assert that a cue-based association will most likely be strengthened through exposure to the domain in question (Cellier & Eyrolle, 1997). Consequently, it could be proposed that experts
from a particular domain will have had a greater opportunity to have observed and, therefore, acquired associations that are highly specific to their domain.

**Hypothesis (3):** It is hypothesised that the experts will rate associations drawn from the expert target sample as being more specific to the domain of profiling compared to those associations drawn from the novice target sample.

### 5.3.1.4 Perceived Cue Diagnosticity

Cue diagnosticity refers to the extent to which a cue is able to diagnose the state of a system (i.e., its predictive validity) (Schriver et al., 2008). Because cues vary in diagnosticity, the presence of one cue in the environment may be enough to diagnose the state of the system, whereas other cues may require the presence of additional cues to make an assessment. The capacity to recognise cue diagnosticity most likely occurs through the accumulation of past cases in long-term memory and feedback in relation to decision outcomes (Morrow et al., 2009). From feedback, it is presumed that operators will learn which cues are more diagnostic and, ultimately, pay more attention to such cues. Consequently, a factor of expertise may be one’s ability to recognise and target highly diagnostic cues. Thus, consistent with previous findings (Morrow et al., 2009; Perry, Stevens, Wiggins, & Howell, 2007; Schriver et al., 2008; Wiggins & O’Hare, 2003), it is presumed that expert decision-makers will possess a greater capacity to recognise diagnosticity compared to their novice counterparts.

**Hypothesis (4):** It is hypothesised that the experts will rate associations drawn from the expert target sample as being more diagnostic compared to those associations drawn from the novice target sample.
5.3.1.5  *Expertise and Cue Discrimination*

It has been asserted that expertise is based on a decision-maker’s ability to discriminate between stimuli consistently (Weiss & Shanteau, 2003; Shanteau, 1992a). Here, expert judgement involves seeing fine gradations among stimuli. Presumably, this ability enables experts to discriminate between cue-based associations, based on their relative usefulness. Indeed, the capacity for a decision-maker to discriminate between associations based on their relative utility underpins the assumption that experts will be able to target the most appropriate associations in a given decision task.

*Research Question.* Do expert decision-makers possess a superior capacity, compared to their novice counterparts, to discriminate between cue-based associations based on their perceptions of frequency of use and strength?

5.3.2  Method

5.3.2.1  *Design*

Study 2b involved the investigation of expert and novice perceptions of a limited number of cue-based associations (20) drawn from both the expert (10) and novice (10) target sample. The design involved the administration of an online survey that utilised several Likert-scale based questions. The study employed a between-subjects design with two independent variables (IV): 1) expertise, comprising two levels (expert and novice); and, 2) the target sample from which each association originated (expert and novice). The dependent variables (DV) were participants’ ratings of perceived frequency of use, strength, domain specificity, and diagnosticity, for each of the associations.
5.3.2.2 Participants

Nine expert (nine male, mean age = 46.3 years) and 19 novice participants (11 male and 8 female, mean age = 22.7) who participated in Studies 1 and/or 2a also participated in Study 2b.

5.3.2.3 Stimuli/Apparatus

Study 2b involved the administration of an online survey that was designed to extract expert and novice perceptions relating to 20 concept pairings (cue-based associations) that were identified in Study 2a. Ten of the pairings constituted the leading associations evident amongst experts in Study 2a (in relation to agreement and response latency). The remaining 10 pairings comprised the leading 10 associations amongst novices. The 20 concept pairings (10 expert and 10 novice) are shown in Table 5.4.

The 20 pairings were listed randomly and participants were asked to rate each pairing on a scale from one to seven, in relation to: how often they use it (frequency of use) (1 = never, 7 = always); the strength of the perceived association between the two concepts (strength) (1 = extremely weak, 7 = extremely strong); how often it is applied outside the domain of profiling (domain specificity) (1 = never, 7 = always); how much does its worth depend on the presence of absence of other information (diagnosticity) (1 = never, 7 = always). A copy of the association perception survey is provided in Appendix G.
Table 5.4

*The 20 Concept Pairings (10 expert and 10 novice) Used in the Survey*

<table>
<thead>
<tr>
<th>Target Sample</th>
<th>Expert</th>
<th>Novice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crime-Related Concept</td>
<td>Offender-Related Concept</td>
<td>Crime-Related Concept</td>
</tr>
<tr>
<td>Destruction of Evidence</td>
<td>Criminal Sophistication</td>
<td>Level of Organisation</td>
</tr>
<tr>
<td>Method of Body Concealment</td>
<td>Degree of Intelligence</td>
<td>Destruction of Evidence</td>
</tr>
<tr>
<td>Method of Approach</td>
<td>Social Competency</td>
<td>Victim Similarity</td>
</tr>
<tr>
<td>Injury Type/Location</td>
<td>Relationship with Victim</td>
<td>Victim Selection</td>
</tr>
<tr>
<td>Staging</td>
<td>Degree of Intelligence</td>
<td>Level of Organisation</td>
</tr>
<tr>
<td>Point/Method of Entry</td>
<td>Degree of Intelligence</td>
<td>Victim Age</td>
</tr>
<tr>
<td>Degree of Force Used</td>
<td>Relationship with Victim</td>
<td>Degree of Force Used</td>
</tr>
<tr>
<td>Staging</td>
<td>Criminal Sophistication</td>
<td>Rituals/Signatures</td>
</tr>
<tr>
<td>Point/Method of Entry</td>
<td>Criminal Sophistication</td>
<td>Victim Maintained</td>
</tr>
<tr>
<td>Degree of Force Used</td>
<td>Post-Event Behaviour</td>
<td>Victim Similarity</td>
</tr>
</tbody>
</table>
5.3.2.4 Procedure

The participants were provided with a hyperlink to an online survey. They were asked to provide ratings on seven-point Likert scales for each perception category (perceived frequency of use, strength, domain specificity, and diagnosticity) for each association.

5.3.3 Results

5.3.3.1 Data reduction

The responses for domain specificity were reversed, so that a higher score would now represent a greater degree of domain specificity. To reduce the number of necessary comparisons across the twenty selected associations, expert and novice survey scores for each association were collapsed into grand means for each target sample (expert and novice), for each perception category.

5.3.3.5 Analysis

Perceived frequency of use. Expert and novice perceptions of the frequency of association use were compared across association target samples to determine whether each group reported using associations drawn from their respective target sample at a greater frequency. Participants’ perception ratings were analysed using a mixed repeated measures analysis of variance (ANOVA), which incorporated the frequency ratings for associations as a within-subjects factor with two levels; expert and novice associations. The between subjects factor, participant expertise, comprised two levels; expert and novice. The assumptions of normality and homogeneity of covariance were satisfactory.

With alpha set at .05, the results revealed a statistically significant main effect for frequency of use, $F (1, 26) = 20.62, p < .00$, partial $\eta^2 = .55$, indicating an overall greater level of perceived frequency of use for associations from the expert sample ($M = 5.22, SD = .82$).
compared to the novice target sample ($M = 4.74, SD = .89$). No significant main effect was found for expertise, $F (1, 26) = .24, p = .63$, partial $\eta^2 = .12$, indicating that the participants from each group reported a similar level of overall frequency of association use. Of most interest to the current analyses is the significant interaction between frequency of use and expertise, $F (1, 26) = 20.91, p < .00$, partial $\eta^2 = .66$. This result indicates a significant difference in perceived frequency of use based on the expertise of the participant and the target sample from which the associations were drawn.

Given this interaction, a dependent samples $t$-test was used to determine whether there was a significant difference between experts’ perceptions of the frequency of use across the two target samples (expert and novice). With a Bonferroni adjusted alpha of .025, and assumptions of normality met, the results revealed a statistically significant difference between the experts’ perceived frequency of use for associations from the expert target sample and their perceived frequency of use for associations from the novice target sample, $t(8) = -3.50, p = .008$. This indicates that the experts reported a significantly greater frequency of use for associations drawn from the expert target sample ($M = 5.83, SD = 0.76$) compared to the novice target sample ($M = 4.31, SD = 1.07$).

A second dependent samples $t$-test was used to determine whether there was a significant difference between novices’ perceptions of frequency of use across the two target samples (expert and novice). With a Bonferroni adjusted alpha of .025, and assumptions of normality met, the results failed to reveal a statistically significant difference between the novices’ perceived frequency of use for associations from the expert sample and their perceived frequency of associations from the novice sample, $t(18) = 1.40, p = .890$. This indicates that the novices reported no significant difference in frequency of use for associations drawn from the expert
target sample ($M = 4.95, SD = 0.74$) compared to those identified by the expert target sample ($M = 4.93, SD = 0.69$).

Together, the results of these two $t$-tests suggest that experts were better able to discriminate between the associations based on their perceived frequency of use, in comparison to the novices. Further, these findings suggest a relatively high degree of consistency amongst the experts in relation to their recognition of associations in the P-CAT and their perceptions of frequency of association use. A comparison of the means for perceptions of frequency for both expert and novice participants, across both target samples, is shown in Figure 5.5.

![Figure 5.5](image-url)

*Figure 5.5. The mean perceived frequency of use (+SE) for each target sample across expertise level.*
Perceived strength. Expert and novice perceptions of association strength were compared across association target samples to determine whether each group reported associations from their respective sample as being stronger than those from their counterparts’ sample. Participants’ perception ratings were analysed using a mixed repeated measures analysis of variance (ANOVA), which incorporated the strength ratings for associations as a within-subjects factor with two levels; expert and novice associations. The between subjects factor, participant expertise, comprised two levels; expert and novice. The assumptions of normality and homogeneity of covariance were satisfactory.

With alpha set at .05, the results revealed a statistically significant main effect for strength, $F(1, 26) = 12.11, p < .00$, partial $\eta^2 = .55$, indicating an overall greater degree of perceived strength for associations from the expert sample ($M = 5.22, SD = .82$) compared to those from the novice target sample ($M = 4.74, SD = .89$). No significant main effect was found for expertise, $F(1, 26) = .059, p = .81$, partial $\eta^2 = .12$, indicating that the participants from each group reported a similar level of overall strength. Of most interest to the current analyses is the significant interaction between perceptions of strength and expertise, $F(1, 26) = 12.51, p = .002$, partial $\eta^2 = .52$. This result indicates a significant difference in perceived strength based on the expertise of the participant and the target sample that the associations were drawn from.

Given this interaction, a dependent samples $t$-test was used to determine whether there was a significant difference between experts’ perceptions of strength across the two target samples (expert and novice). With a Bonferroni adjusted alpha of .025, and assumptions of normality met, the results revealed a statistically significant difference between the experts’ perceived strength for associations from the expert target sample and their perceived strength for associations from the novice target sample, $t(8) = 2.81, p = .013$. This indicates that the experts
reported greater strength for associations drawn from the expert target sample ($M= 5.51, SD = 1.21$) compared to those associations from the novice target sample ($M= 4.31, SD = 1.04$).

A second dependent samples $t$-test was used to determine whether there was a significant difference between novices’ perceptions of strength across the two target samples (expert and novice). With a Bonferroni adjusted alpha of .025, and assumptions of normality met, the results failed to reveal a statistically significant difference between the novices’ perceived frequency of use for associations from the expert sample and their perceived frequency of associations from the novice sample, $t(18) = .076, p = .94$. This indicates that the novices reported no significant difference in strength for associations drawn from the expert target sample ($M = 4.79, SD = 0.68$) compared to those identified by the expert target sample ($M = 4.78, SD = 0.58$).

Together, the results of these two $t$-tests suggest that experts were better able to discriminate between the associations based on their perceived strength, compared to the novices. Further, these findings suggest a relatively high degree of consistency amongst the experts in relation to their recognition of associations in the P-CAT and their perceptions of association strength. A comparison of the means for perceptions of association strength for both expert and novice participants, across both target samples, is shown in Figure 5.6.

*Perceived Domain Specificity.* Expert participants’ perceptions of domain specificity were compared across the expert and novice target samples to determine whether the experts rated associations drawn from the expert target sample as being more specific to the domain of profiling compared to those associations drawn from the novice target sample.
Figure 5.6. The mean perceived strength of association (+SE) for each target sample across expertise level.

A dependent samples t-test was used to determine whether a significant difference existed between experts’ perceptions of domain specificity across the two target samples (expert and novice). With alpha set at .05, and assumptions of normality met, a statistically significant difference was found between the experts’ perceived domain specificity across the novice and expert target samples, $t(8) = -3.947, p = .004$. The mean perceived domain specificity for the expert target sample of 5.51 ($SD = 2.51$) was significantly greater than the mean of 4.31 ($SD = 0.64$) for the novice target sample. A comparison of the expert mean perceptions of domain specificity across the expert and novice target samples is shown in Figure 5.7.
Perceived Diagnosticity. Expert participants’ perceptions of diagnosticity were compared across the novice and expert target samples to determine whether the experts rated associations drawn from the expert target sample as being more diagnostic than those associations drawn from the novice target sample.

A dependent samples $t$-test was used to determine whether a significant difference existed between experts’ perceptions of diagnosticity across the two target samples (expert and novice). With alpha set at .05, and assumptions of normality met, a statistically significant difference was found between the experts’ perceived diagnosticity for associations from the expert target sample and associations from the novice target sample, $t(8) = 2.58, p = .004$. The experts’ mean perceived diagnosticity for the expert target sample of 5.98 ($SD = 1.91$) was significantly greater
than their mean of 3.97 ($SD = 1.10$) for the novice target sample. A comparison of the expert mean perceptions of diagnosticity across the expert and novice target samples is shown in Figure 5.8.

![Figure 5.8](image)

*Figure 5.8.* The experts’ mean perceived diagnosticity (+SE) for each target sample.

The findings regarding expert and novice perceptions across both target samples (novice and expert) are summarised in Table 5.5.
Table 5.5.

A Summary of Expert and Novice Perceptions across Expert and Novice Target Samples

<table>
<thead>
<tr>
<th>Sample</th>
<th>Perceived Frequency of Use</th>
<th>Perceived Strength of Association</th>
<th>Perceived Domain Specificity</th>
<th>Perceived Diagnosticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novices’ Perception</td>
<td>No difference</td>
<td>No difference</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

5.3.4 Discussion

The aim of Study 2b was to investigate expert and novice perceptions of a selection of associations extracted from each of the target samples identified in Study 2a (expert and novice). More specifically, Study 2b involved the investigation of four areas of interest from the literature relating to cue-use and decision performance.

5.3.4.1 Perceived Frequency of Use

It was hypothesised that participants would report a higher level of use for associations that originated from their respective target sample (expert and novice). The current findings partially support this hypothesis with experts’ perceptions of frequency suggesting a greater tendency to engage the expert target sample over the novice target sample. This finding is consistent with Anderson’s (1993) principle of strength in relation to cognitive productions, which stipulates that the repeated exposure and successful application of a production increases the likelihood that it will be used in the future. These findings suggest that response latency, as used in the P-CAT, provides an indication of an individual’s relative frequency of association activation, whereby, the more rapid the recognition, the greater the perceived frequency of
activation. These results support the use of the P-CAT as a means of distinguishing expert and novice cue activation and, in turn, the identification of a set of cue-based associations used frequently by experts, for use in training and support systems. However, this finding was not replicated in the novice sample.

It may be presumed that many of the expert cues, which may not be recognised by the novice sample in the P-CAT, may be deduced as valid associations on longer inspection (i.e., when examining the survey). Consequently, it is proposed that the recognition of an association as valid may have impacted the novices’ perceptions of its previous use, whereby a novice may have misrepresented their actual perceptions by rating a frequent level of use.

5.3.4.2 Perceived Strength

It was hypothesised that expert and novice profilers would report a greater level of perceived strength for associations within their respective samples (expert and novice). The current findings partially support this hypothesis, as the experts rated the associations from the expert target sample as significantly stronger than the associations from the novice target sample. This suggests that response latency, as used in the P-CAT, appears to be a valid indicator of perceived cue strength, adding further support to the P-CAT as an objective means of not only validating cues extracted using interview techniques, but in identifying a high-frequency, highly valid, expert set of cue-based associations.

Again, no such difference was found for the novice group, and again, it may be presumed that many of the associations, which may not be recognised by the novice sample, may be deduced as valid and particularly strong, associations on longer inspection.
5.3.4.3 *Perceived Domain Specificity*

It was hypothesised that the experts would rate associations drawn from the expert target sample as more specific to the domain of profiling compared to those associations drawn from the novice target sample. The findings supported this hypothesis, revealing that the experts rated perceived domain specificity for associations from the expert target sample significantly higher than associations from the novice target sample. This suggests that decision-makers’ cue-use is partly moderated by their degree of operational experience within a particular domain. It also suggests that decision performance may be regulated by the decision-makers’ store of domain-specific cue-based associations. Thus, one could make an argument that exposure to domain-specific cue-based associations may be beneficial to improving novice performance (a notion explored in Study 3).

5.3.4.4 *Perceived Diagnosticity*

It was hypothesised that experts would rate associations drawn from the expert target sample as more diagnostic (i.e., having a greater degree of predictive validity) compared to those associations drawn from the novice target sample. The results supported this hypothesis, revealing that experts rated the associations drawn from the expert target sample as having a greater degree of diagnosticity than those from the novice target sample. This capacity to recognise diagnosticity is well supported in the literature (Morrow et al., 2009; Schriver et al., 2008; Stokes et al., 1992; Wiggins & O’Hare, 2003).

The current findings suggest that the P-CAT was able to discriminate between relevant and less relevant cues on the basis of differences in response latency. Consequently, it can be concluded that the P-CAT can be used to identify a number of highly relevant expert cues and their associated concepts, which may be embedded within training initiatives in an attempt to
improve novice performance. Indeed, in numerous cases, it has been demonstrated that participants’ ability to target relevant cues was the best predictor of performance (Morrow et al., 2009; Schriver et al., 2008; Wiggins & O’Hare, 2003).

5.3.4.5 Expertise and Cue Discrimination

A research question was posed as to whether expert decision-makers possess a superior capacity, compared to their novice counterparts, to discriminate between cues (and their associations) based on their perceived frequency of use and strength. The findings revealed significant differences in expert perceptions of frequency and strength between the target samples (expert and novice). However, no such differences were found for the novice group.

The differences in perceptions across the two target samples demonstrated by the experts, and the lack thereof demonstrated by the novice group, suggests that experts do indeed possess a superior capacity to discriminate between cues (and their associations) based on their relative utility. This is consistent with claims that expertise is based on a decision-maker’s ability to discriminate between stimuli consistently, and presumably, in a way which leads to the selection of best cues in a given situation (Shanteau, 1992a; Weiss & Shanteau, 2003). This would suggest that, by comparison, novices are unable to engage the appropriate cue-based associations in a given task, which may ultimately contribute to an inferior level of decision-making performance.

5.3 GENERAL DISCUSSION

The experimental findings suggest that key differences exist in cue activation (and presumably use) as a function of expertise. Further, it would appear that the P-CAT was successful as an objective means of gauging the relative strength of a cue (and its potential associations), and, consequently, led to the identification of a number of cue-based associations that appear to be used frequently by experts, and that novices may not recognise or may use less
frequently. The proposed relationship between response latency and associative strength was further supported by participants’ perceptions of the associations. Moreover, participants’ perceptions suggest that the expert target sample possesses a high degree of operational validity.

It remains relatively unclear, however, whether the demonstrated differences in cue activation (and presumably use) are a reflection of, or a precursor to, expertise. If the differences are a reflection of expertise, it is possible to use the P-CAT as a form of competency test. On the other hand, if they represent a precursor, it may be possible to use the P-CAT as a cue selection process (as intended) for both computer-based training and decision support systems. The precise role of cues in overall decision performance, and thus, expertise development, will be investigated in Study 3.

5.4 CHAPTER SIX BRIEF

Chapter Six details Study 3, which will investigate whether novices’ acquisition of the expert-cue-based associations is beneficial to their decision-making performance. More specifically, Study 3 will examine whether: 1) a significant improvement in novices’ recognition of expert cue-based associations in the P-CAT will be matched by improvements in decision-making performance in a profiling task; and, 2) the extent to which any improvement in decision performance may be prevalent in a task representative of a naturalistic setting.
STUDY 3:  
THE IMPACT OF ASSOCIATED CONCEPTS EXPOSURE (ACE) TRAINING ON CUE ACTIVATION AND DECISION PERFORMANCE
“I see no more than you, but I have trained myself to notice what I see.”

- Sherlock Holmes, in “The Adventure of the Blanched Soldier”
6.1 STUDY OBJECTIVE

The overall aim of this thesis was to investigate potential differences in cue activation (and presumably use) across two stages of expertise (expert and novice), and to determine whether it is possible to improve novice decision-making performance based on a modelling of expert cue activation. In so doing, first, the differences in cue activation across expertise observed in Study 2a must be reduced. Study 3 will employ a form of cue-based training designed to expose novice profilers to a limited number of cue-based associations typically used by expert profilers. In doing so, it is expected that novices will significantly improve their recognition/activation of expert associations (as assessed by the P-CAT).

Upon improving novices’ recognition of the expert cue-based associations, it will be possible to examine whether such improvements in cue activation are matched by concomitant improvements in their decision-making performance, and thus, the extent to which differences in decision performance across expertise can be attributed to differences in cue activation (and presumably use) across expertise. Overall, the findings will provide a greater understanding of the role of cues in the development of expertise.

Two phases of study are reported. The first (Study 3a) will employ an experimental training program, Associated Concepts Exposure (ACE) training, to aid participants’ acquisition of a number of expert cue-based associations. The study aims to determine whether exposure to expert associations, in a manner consistent with the P-CAT presentation (i.e., concept pairings in the absence of contextual variables), results in a significant improvement in participants’ recognition of expert cue-based associations (as assessed by the P-CAT). In contrast to the previous studies, Study 3a will involve the use of participants who are naïve to the context from which the cue-based associations were drawn. The purpose of this strategy is to ensure that any
observed improvements in recognition could be attributed solely to the ACE training, and to the incorporation of new cue-related knowledge without previously acquired contextual knowledge.

Two tools will be used in Study 3a. Firstly, a training tool designed specifically for this study, the ACE training program, will be used to expose naïve participants to a set of expert cue-based associations (as identified in Study 2a). Secondly, to assess pre- and post-training cue activation, the P-CAT (from Study 2a) will be used. The commencement of Study 3b is contingent upon the success of the ACE training program improving naïve participants’ recognition of the expert cue-based associations (i.e., their cue activation) in the P-CAT.

Study 3b will again use ACE training to teach a set of expert cue-based associations to participants; this time amongst novice participants, who possess some degree of awareness of the operational context. This phase of study will determine whether potential improvements in novice recognition of expert associations (as anticipated in Study 3b), are matched by concomitant improvements in several facets of decision-making performance, including decision accuracy, time, and information acquisition. This phase will also seek to determine whether novice decision performance is impacted by the extent to which the decision scenarios engaged reflect a naturalistic setting.

Three tools will be used in Study 3b: the ACE training program; the P-CAT; and, a decision assessment interface. The decision assessment interface will operate as a surrogate for the operational environment, enabling users to explore, acquire, and integrate cue-based information in quasi-realistic profiling decision tasks. The interface will be used to assess participants’ decision performance, including performance variables such as decision accuracy, time, and information acquisition. The interface will be administered prior to, and following, ACE training.
6.2 STUDY 3A: THE EFFECT OF ACE TRAINING ON NAÏVE CUE ACTIVATION

6.2.1 Background/Rationale

Cue-based training commonly takes two forms, the first of which is based on the notion of cue discovery (Klayman, 1988). These methods involve the intended acquisition of cues during some form of simulation of the relevant operational environment. Generally, through interaction with a scenario, it is presumed that users will spontaneously recognise relationships between concepts, and hence, identify the appropriate cues to engage. For example, Klayman (1988) observed that enabling learners to discover the cues associated with a task resulted in subsequent improvements in the learner’s ability to predict the behaviours of a computer-controlled graphic display.

Although cue discovery training allows the trainee to acquire meaningful cues in a task representative of the operational environment, many organisations do not possess the time, nor the resources, to enable trainees to progress from novice to expert through the simulation of operational experience. As such, other forms of cue-based training have attempted to speed trainees’ acquisition of expert-oriented knowledge.

The second form of cue-based training involves promoting the trainee’s awareness of task-relevant cues (Zsambok & Klein, 1997). Here, trainees are supplied with a pre-identified number of presumably valid cues (generally identified through cognitive interviews with experts), which they must engage to navigate a decision scenario. Consistent with cue discovery, this form of training generally involves some level of simulation or critical decision to be resolved by the trainee. For example, Wiggins and O’Hare (2003) developed a computer-based training system designed to enable pilots to identify critical cues associated with deteriorating weather conditions during flight. Case-specific information pertaining to the cues was accessed
by dragging a cursor over various features within weather-related images. Subsequently, participants were asked to identify the point at which weather conditions deteriorated to an unacceptable level.

The aim of this type of training has been to expose the learner to cues that are useful as triggers for diagnosis. However, while this form of training has been found useful for improving novices’ attention management skills (Fisher & Pollatsek, 2007), the capacity for trainees to trigger meaningful associations in memory remains limited (Beilock et al., 2002), potentially reducing the advantages associated with expert cue-use in reducing the demands on working memory (Wickens & Hollands, 2000).

Although it is consistent with the principles of this form of cue-based training, the current work extends this approach by not only exposing learners to expert cues (i.e., improving cue selection), but also exposing them to a limited number of expert associations between cues and other relevant concepts, typically triggered during expert decision-making. Indeed, the current thesis proposes a third form of cue-based training based on the modelling of expert cue activation: Associated Concepts Exposure (ACE) training.

Using the crime concept → offender concept conceptualisation of offender-profiling cue-based associations, trainees are presented with a number of pre-identified conceptual associations used frequently by experts (as validated via the P-CAT). ACE training differs from the aforementioned forms of training, cue discovery and cue awareness, in two ways. Firstly, although it is based on the presentation of a critical cue inventory as commonly used in other forms of cue-based training, ACE training explicitly provides the trainee with both a representation of the cue and an associated concept. Thus, by exposing novices to cue-based associations, it may be argued that a degree of meaning is provided to the user. Moreover,
consistent with Chater and Oaksford’s (2007) claims, it is theorised that an explicit explanation of the relationship between the elements of cues is likely to increase the rate at which those cues are acquired.

Secondly, as ACE training is designed to improve cue activation alone, associations are presented in the absence of a context, simulation, or a required decision. If there is a significant difference in post-training cue activation, the mere exposure to a valid set of expert cue-based associations may offer an attractive option for cue-based training programs. Indeed, ACE training would be a cost-effective alternative, or precursor to, many programs based upon the simulation of the operational environment. Of course, any improvement in cue recognition must be assessable, and that has proven difficult for two reasons. Firstly, whether a cue set has been acquired during cue-based training is often secondary compared to gauging improvements in overall task performance and has mostly been overlooked by researchers. Secondly, there has been no objective means for assessing/monitoring recognition or the rate of acquisition. The P-CAT has been used successfully in Study 2a of the current thesis to measure cue activation amongst both expert and novice decision-makers. Consequently, it is theoretically possible to assess trainees’ cue acquisition by measuring their cue activation prior to, and following, training.

6.2.2 Aim/Research Question

The aim of Study 3a is to test whether exposure to a set of expert cue-based associations (the expert target sample identified in Study 2a) in the absence of contextual variables, can improve participants’ recognition of a set of expert cue-based associations, as assessed by the P-CAT. In contrast to the previous studies, Study 3a will involve the use of participants who are naïve to the context from which the cue-based associations were drawn. The purpose of this
strategy is to ensure that any observed improvements in recognition could be attributed solely to the ACE training, and to the incorporation of new cue-related knowledge without previously acquired contextual knowledge.

6.2.3 Method

6.2.3.1 Design

The experiment comprised a within-subjects, two group, pre-/post-test, design. The Independent Variable (IV) was the mode of intervention between pre- and post-testing, which incorporated two levels: training and no training.

The Dependent Variable (DV) was participants’ recognition of cue-based associations from the expert target sample (identified in Study 2a), which was assessed using: 1) a pen and paper task subsequent to the implementation of the IV. This was a performance-check to ensure that participants had made a serious attempt to devote the pairings to memory. Participants who scored greater than 80% recognition were asked to complete the post-training condition; and 2) response latency on the P-CAT task (prior to and after the implementation of the IV).

6.2.3.2 Participants

The 20 naive participants involved in the study were drawn from a sample of convenience (12 male and eight female, mean age = 25.3 years).

6.2.3.3 Stimuli/Apparatus

Participants received the P-CAT prior to, and following, the intervention (ACE training). The 41 crime-related and 28 offender-related profiling concept labels identified in Study 1 and used in the P-CAT in Study 2a, were used as the P-CAT stimulus in Study 3. As Study 3a involved participants engaging the ACE training program and the P-CAT (twice) in the same sitting, the number of concept pairings presented in each P-CAT session was reduced from 1148
(as used in Study 2a) to 168, to minimise the potential effects of fatigue. The 168 trials consisted of the 46 concept pairings from the expert target sample (see Appendix H) and 122 randomly selected distracter pairings (drawn from the 1102 remaining possible pairings).

The P-CAT was presented to participants on a laptop computer (LG, 17” colour monitor, ATi Mobility X1400, 1GB DDR2 667 MHz RAM) via DMDX software (Forster & Forster, 2003), which collected participants’ classification response latencies. The same laptop was used for all participants to maintain a consistent screen refresh rate of 16.46ms.

Compared to the previous format of the P-CAT used in Study 2a, the current version was modified slightly based on qualitative feedback from the participants, who reported a dislike for the simultaneous presentation of concepts (directly subsequent to the priming), describing it as unnecessary and potentially distracting as, although participants already processed the prime, on numerous occasions they reported that their attention was often drawn to the left of screen unnecessarily.

To avoid such potential distractions, concept presentation subsequent to the initial priming was instead offset, so that the prime concept was displayed briefly (left of screen) prior to the (potentially associated) concept (right of screen). Several arrow marks were presented at the centre of screen to aid participants’ tracking of information. The revised P-CAT script for use in DMDX is provided in Appendix I (specific concept label combinations were counterbalanced). Consistent with the use of the P-CAT in Study 2a, two labels were posted at the top of the computer screen differentiating the crime-related concept (left of screen) from the offender-related concept (right of screen) to aid the orientation of participants. An additional two labels were used to designate each shift key as either the Yes (right shift key) or No (left shift
For the training condition, participants received ACE training, which was run on DMDX software (Forster & Forster, 2003). The ACE training program script for use in DMDX is provided in Appendix J (specific concept label combinations were counterbalanced). The expert cue-based associations identified in Study 2a (expert target sample) were used in the ACE
training strategy (i.e., the desired cues to be acquired by participants). This set comprised 46 concept pairings from the domain of offender profiling (see Appendix H). The transfer of skill between training and actual operation is said to be maximised when the stimulus presented in each is identical (Thorndike & Woodworth, 1901). As the ACE training program was specifically designed to improve participants’ performance on the P-CAT, the training process incorporated identical elements where possible.

Consistent with the P-CAT, the ACE training program presented concepts to participants in pairs. However, differences between the two programs include: 1) the simultaneous presentation of concepts; 2) pairs are presented for an extended interval of time (5764.5 (ms) per presentation) to promote the acquisition of meaning; 3) each pair is presented a total of three times; and, 4) participants are not required to formulate a response to the presentation. An example of the sequence of screen presentations within the ACE training program is shown in Figure 6.2. Upon completion of each of the four training blocks, participants received a pen and paper recognition task, which required them to sort concept labels into valid pairings as seen in the P-CAT (see Appendix K).

1.  

![Pairing One Is.....](image1)

2.  

![Victim Age Gender](image2)

*Figure 6.2. An example of the sequence of screen presentations within the ACE training program.*
6.2.3.4 Procedure

Pre-intervention (P-CAT). The participants were seated in front of the laptop computer. Prior to the P-CAT test trials they completed 12 familiarisation trials, each consisting of a single concept pairing. Familiarisation trials consisted of several associations that were based on assumed common knowledge (e.g., sky + blue). Several incongruent pairs were also used (e.g., sky + crocodile) (see Appendix D for complete listing of familiarisation trials). Participants were instructed that the pairs to be used in the test condition would all be drawn from the domain of offender profiling. However, no exemplar pairs were provided as a means of avoiding exposure bias. Prior to commencing the test condition, participants were provided with the list of profiling-related concept labels to ensure that they were familiar with the terminology used. After it was confirmed that all terminology was understood correctly, participants began the test condition.

For each test trial, participants were briefly presented with a crime-related concept label at the centre of the screen (3292ms). Subsequently, this screen was replaced with the presentation of the same concept label on the left side of screen for 1646ms. After the concept disappeared from the screen, several arrow marks (e.g., >>>>>>>>) were presented at the centre of screen for 1234.5ms to prompt the user’s attention to the right of screen. After the arrows disappeared, an offender-related concept label was presented on the right side of the screen for 1646ms.1

For each presentation, participants were instructed to decide whether each pairing was associated by striking either the right (Yes) or left (No) shift keys on the computer provided, as quickly as possible. The test phase consisted of two blocks of presentations. Each block consisted of 84 trials that constituted the combination of 12 crime-related concepts paired with seven offender-related concepts, a total of 168 trials (24 crime-related and 14 offender-related concepts) consistent with the presentation durations of Study 2a.
concepts) in the experimental session. Participants were given the opportunity to rest between blocks, if desired.

*Intervention (ACE Training).* Upon completion of the pre-intervention test and a brief rest-period, participants engaged one of two conditions; *training or no training.* This was designed to ensure that any observed improvement in the post-intervention condition could be attributed, primarily, to the participants’ engagement in the ACE training, and was not the result of experience with the task.

In the training condition, participants were again seated in front of the laptop. Prior to commencing the training condition, participants were informed that they would be shown a number of paired concept labels that were reported as strongly associated by a number of expert offender profilers (expert target sample from Study 2a). Further, participants were asked to commit these pairings to memory.

The training condition employed the use of the ACE training program. For each trial, participants were briefly presented with a crime-related concept label on the left side of screen simultaneously with an offender-related concept label presented on the right of screen. As the aim of the training condition was not to promote recognition memory, as intended within the P-CAT, but instead to promote acquisition, presentation time was increased to 5764.5ms\(^2\). Participants were not required to respond to any of the presentations. The ACE program consisted of four levels. Each level comprised a number of trials (12, 12, 11, and 11, for a total of 46), and was repeated three times to promote acquisition. Participants were given the opportunity to rest between levels, if desired.

Subsequent to the completion of each level, participants were asked to undertake a brief pen and paper recognition task. This task listed the crime-related concepts displayed in each

\(^2\) Approximately 3.5 times the presentation duration in the P-CAT.
level and asked participants to tick a box next to the offender-related concepts that, according to the training that they had received, shared an association. This procedure was conducted as a performance-check to ensure that participants had made a serious attempt to devote the pairings to memory. Participants who scored greater than 80% recognition were asked to complete the post-training condition.

In the no training condition, participants did not receive the ACE program. Instead, upon completion of the pre-intervention test and a brief rest-period, participants were asked to complete the pen and paper recall tasks in the absence of any training. In contrast to the training condition, participants in the no training condition were simply asked to tick a box next to the offender-related concepts that they believed to share an association. This task was not employed as a form of assessment, but rather, to control for the potential impact of completing the task, on post-intervention performance, and to create a similar time interval between pre- and post-intervention to that evident in the training condition.

Post-intervention (P-CAT). The post-intervention condition was consistent with the pre-intervention condition for both training and non-training groups, with the exception of the familiarisation protocol and the order in which the concept pairs were presented. Each concept pairing presentation within each block, and each block itself, was counterbalanced to control for practice effects.

6.2.4 Results

6.2.4.1 Data Reduction

Participant response latencies in the P-CAT (from the point of the offender-related concept label presentation onset), were recorded for each concept pairing presented. All
participants who received the training condition scored greater than 80% on the pen and paper recognition task and, thus, no participants were excluded from the post-intervention condition.

6.2.4.2 Analyses

Training Group. The aim of this analysis was to determine whether there was a difference in response latency between pre- and post-intervention conditions for those associations presented during training (46 concept pairings from the expert target sample), and whether this potential difference could be attributed to participants receiving ACE training. It was considered unnecessary to employ a statistical test to examine whether there were significant differences between pre- and post-intervention latencies for each of the 46 variables, as such tests would unnecessarily increase the potential for a Type I error. Instead, participant response latencies for each of the 46 associations from the expert target sample were collapsed into a grand mean. The grand means from the training and no training groups were compared across the pre- and post-intervention conditions.

A mixed measures analysis of variance (ANOVA), incorporating the intervention condition as a within-groups factor with two levels (pre-intervention and post-intervention), and intervention type as a between-groups factor with two levels (training or no training), examined whether response latency differed across conditions for each group. Prior to collapsing scores into the grand means, screening of the data revealed 42 outliers for the time taken to respond. The outliers were converted to the next extreme score, plus one (Tabachnick & Fidell, 2005). The assumptions of normality and homogeneity of covariance were satisfactory.

The results revealed a statistically significant main effect for intervention condition, $F(1, 18) = 10.74, p = .004$, partial $\eta^2 = .54$, indicating an overall decrease in response latency from the pre-intervention ($M = 1090.27, SD = 143.53$) to post-intervention conditions. A significant effect
was also found for intervention type, $F(1, 18) = 18.31, p < .00$, partial $\eta^2 = .60$, indicating that the participants in the training group demonstrated significantly shorter response latencies ($M = 952.24, SD = 105.95$) than the participants in the no training group ($M = 1116.13, SD = 150.62$). Of most interest to the current analyses is the significant interaction between intervention condition and intervention type, $F(1, 18) = 10.98, p < .00$, partial $\eta^2 = .58$. Post-hoc comparisons using the Bonferroni correction indicated a significant decrease in response latency for the training group from pre-intervention ($M = 1081.55, SD = 140.94$) to post-intervention ($M = 822.92, SD = 70.62$) conditions; no such improvements were revealed for the no training group. These results suggest that those participants who received ACE training subsequently improved their recognition of the expert target sample in the P-CAT, while those who did not receive ACE training did not improve significantly. Ultimately, these results suggest that the observed improvement of participants who received the training intervention was primarily attributable to the training strategy employed, and not a factor of task experience. The mean response latencies for the expert target sample, for pre- and post-intervention stages, for both the training and no training groups, are presented in Figure 6.3.

6.2.5 Discussion

The aim of Study 3a was to test whether exposure to a set of expert cue-based associations (the expert target sample identified in Study 2a) in the absence of contextual variables, could improve naïve recognition of a set of expert cue-based associations, as assessed by the P-CAT. The findings revealed a significant improvement in naïve recognition subsequent to ACE training, suggesting that the ACE training was successful in aiding naïve participants’ acquisition of a set of expert cue-based associations.
The current findings may have implications for the design and development of future cue-based training programs. Although it would be unwise to suggest that ACE training, in its current form, represents a comprehensive skill development program, it may act as a useful, cost-effective, precursor to other forms of training, such as decision simulations. In this sense, trainees may first be provided the right tools for the job, prior to their application; potentially reducing both learning time and error.

The primary limitation associated with the present study, as previously outlined in Studies 1 and 2, was the use of text-based labels to represent concepts. A decision-maker will most likely use an array of information media in the environment. For instance, a profiler will scan a scene for visual evidence such as blood spatter and, for the same case, listen to witness statements (Hazelwood et al., 1995); a combination of audio and visual information. This is of particular concern for those individuals who may have a preference for visuo/spatial information.

Figure 6.3. The mean response latencies (+SE) for the expert target sample, for pre- and post-intervention stages, for both the training and no training groups.
(Kampwirth & Bates, 1980). As this is the second study to examine profilers’ cue activation using the P-CAT, future studies may seek to expand the research to include other domains of interest, which may have a more consistent medium of cues (e.g., the examination of physical evidence by forensic investigators (Morrison et al., 2010)).

A further limitation may exist in the use of naïve participants. This may have allowed for a greater range/opportunity for significant improvement in response latency compared to decision-makers of other levels of expertise. Consequently, Study 3b will incorporate participants at a relatively higher level of expertise (novices) to gauge the effectiveness of ACE training beyond the naïve decision-maker.

Overall, the findings suggest that the recognition/activation of expert cue-based associations, as measured by the P-CAT, can be improved by exposing the decision-maker to said associations, in the absence of simulation, context, procedural knowledge, or a required decision. However, the ultimate value of such improvements, in regard to potential improvements in decision-making performance, has yet to be determined. Study 3b will incorporate an additional phase of testing. A decision assessment interface will be engaged by participants prior to, and following, training, to determine whether an improvement in cue activation (i.e., the recognition of expert-cue based associations) has a beneficial affect on decision-making performance.

6.3 STUDY 3B: THE POTENTIAL IMPACT OF IMPROVED CUE ACTIVATION ON NOVICE DECISION PERFORMANCE

6.3.1 Background/Rationale

In Study 3a, a significant improvement in naïve participants’ recognition of expert cue-based associations was demonstrated. It was concluded that this improvement in cue activation
could be attributed to participants’ engagement in ACE training. However, it remains unclear whether such improvements in cue activation will: 1) be prevalent in a novice population that has awareness (albeit limited) of the operational context; 2) correspond with an improvement in decision-making performance; and, 3) the extent to which any improvement in decision-making performance can occur in a task which is highly representative of a naturalistic setting.

Decision-making performance can be assessed in numerous ways. Obviously, the ability to formulate an accurate response is ideal. However, other aspects of the decision-making process, such as efficiency, also distinguish non-experts from experts. Indeed, decisions are made in real-time, with decision-makers often facing situations in which they are pressured to formulate a response in a timely manner (Sweller, 1988). In many applied decision problems, efficiency is as vital as accuracy (Klein et al., 1986). As such, the time taken to formulate a decision is a crucial aspect of real-world decision-making performance. A variable closely related to decision time, is information acquisition.

Experienced practitioners tend be more judicious than inexperienced practitioners in both the acquisition and the integration of information during decision-making (Hutton & Klein, 1999). Indeed, in many cases, highly experienced decision-maker may only require a limited set of cues to formulate a decision (Shanteau, 1992b). Consequently, experts will often possess a capacity to recognise and interpret meaningful information within the operational environment rapidly and effortlessly. In comparison, inexperienced decision-makers are less rapid; more deliberate, and more linear and sequential in regard their acquisition and processing of decision-related information (Larkin, McDermott, Simon, & Simon, 1980).
The current study will examine each of the three aspects of decision-making performance (accuracy, time, and information acquisition) as a basis for measuring improvements in novices’ overall decision-making performance prior to, and following, training.

6.3.2 Aim/Research Question

The aim of Study 3b is to determine: 1) whether a significant improvement will occur in novice (naïve participants were used in Study 3a) recognition of expert cue-based associations on the P-CAT following ACE training; 2) whether a significant improvement on the P-CAT will be matched by a significant improvement in decision-making performance (assessed using a decision assessment interface), in a number of areas, including: accuracy; time; and, information acquisition; and, 3) the extent to which any improvement in decision performance can occur in a task which is representative of a naturalistic setting.

6.3.3 Method

6.3.3.1 Design

Study 3b consisted of two (non-linear), within-subjects, pre-test, post-test designs, each centred on a training intervention. 3 Firstly, a pre-training vs. post-training assessment of decision-making performance was undertaken using a decision assessment interface (detailed in the stimuli/apparatus section). This stage employed a mixed, pre-test/post-test design. The Independent Variable (IV) was the type of extraction method for the crime-related information within the assessment interface; implicit or explicit (detailed in stimuli/apparatus). The Dependent Variables (DV) were decision accuracy (correct vs. incorrect identification of person of interest), time to complete (the time taken, in seconds, to complete a decision scenario), and

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3 No control group (no training) was used in Study 3b for two reasons: 1) the findings of Study 3a revealed no significant difference in performance on the P-CAT for the control group; and, 2) as Study 3b avoided exposure bias by utilising novice participants who did not participate in Studies 1 or 2, there existed a shortage of novice profilers available for recruitment.
information acquisition during interface engagement (the number of features viewed (total number of accesses) and used (total number of concept labels)).

Secondly, between the two stages of decision assessment (pre-training vs. post-training), a pre-training and post-training assessment of cue activation was recorded using the P-CAT. The Dependent Variables (DV) were response latency to the expert target sample in the P-CAT, and consistent with Study 3a, scores on a pen and paper recognition task that was used as a post-training performance threshold check. A diagrammatic flow chart of the experimental design of Study 3b is provided in Figure 6.4.

6.3.3.2 Participants

The participants comprised 24 novice profilers (10 male and 14 female, mean age = 22.9 years). They were drawn from several learning backgrounds, including Behavioural Science, Criminal Investigative Analysis, Behavioural Analysis, Forensic Science, Forensic Psychology, and Policing/Criminology. The classification of *novice* was consistent with the process outlined in Studies 1 and 2.
6.3.3.3 Stimuli/Apparatus

Study 3b involved the use of a decision assessment interface that was designed and developed in-house. The interface was designed to operate as a surrogate for the operational environment, in this case, the offender profiling process. The interface provides an opportunity for controlled manipulation of a naturalistic decision scenario, which, for many domains (including offender profiling), is impractical to observe naturally. The assessment interface is an online program that presents the user with several screens that are intended to reflect a decision task encountered by profilers.

The assessment interface initially presents the user with a brief outline of a scenario. The scenario describes the occurrence of a serious violent crime that is to be investigated. A crime scene graphic accompanies the scenario. This picture is offered to enhance the users’ spatial conceptualisation of the crime scene, rather than providing specific variables for deliberation. These graphics were constructed based on crime-scene photos and case descriptions using a forensic investigation template within Microsoft Visio. An example of a crime scene graphic used in the decision assessment interface is provided in Figure 6.5.

After continuing past the introduction screens, the interface then offers the user a more expansive representation of the scenario, presented by the interface in one of two forms, each differing in the extent to which they reflect a naturalistic setting. Firstly, within the implicit interface, crime-related concepts of interest to an investigation are embedded within a summary of the case; no attempt has been made by the programmer to highlight or extract the most pertinent concepts of interest. The scenario best reflects a naturalistic operational environment.
The second type of interface, *explicit*, outlines the crime-related concepts (cues) of interest to the user. Here, presumably the user does not have to transfer this information into conceptual categories, and is ready to trigger associations with the offenders’ respective features. This method best reflects an artificial operational environment such as that evident in decision support systems, and is most consistent with the method of information presentation used in the ACE training program. A comparison of the implicit and explicit styles of interface as seen in the decision assessment interface is shown in Figure 6.6.
**Figure 6.6.** A comparison of the implicit (left) and explicit (right) styles of interface as seen in the decision assessment interface.

Ch 6: Study 3 - Cue Activation and Decision Performance 161
After acquiring information from the scenario, users are offered three persons of interest (commonly known as suspects). They are asked to formulate a decision as to which person of interest is most likely to be the offender in the given case. To make this decision, users are supplied with information regarding each person, presented in a list of clickable icons. These icons represent the offender-related concept labels presented during training. When clicked, the case-specific value of the concept is displayed. For example, when the concept label degree of intelligence is clicked, the case specific value of this feature (e.g., above average) is displayed.

To help limit the amount of information that users need to hold within working memory, the interface is designed to present the option-related information in a manner that is consistent with natural processing methods of less-experienced decision-makers (Harris & Wiggins, 2008; Morrison et al., 2010; Perry, Wiggins, Childs, & Fogarty, 2009; Wiggins & Bollwerk, 2006). In doing so, the interface employs an all options, full control interface (Morrison, et al.), which is designed to limit the amount of information held in working memory at any point in time, by allowing the user to compare concept values across each option (person of interest) simultaneously.

This approach to information management has proven beneficial to novice decision-makers in reducing users’ perceived cognitive load associated with using an interface to compare multiple options (Harris & Wiggins, 2008; Morrison et al., 2010; Wiggins & Bollwerk, 2006). Screen shots of the assessment interface process and the two possible interface styles (implicit and explicit) that participants could receive are displayed in Figure 6.7. A complete animated demonstration of both an implicit scenario and an explicit scenario is provided in Appendix L.
Figure 6.7. Screen shots of the decision assessment interface and the two possible interface styles (implicit and explicit) participants could receive.
Four scenarios, based on real-life cases (Edwards, 2002; Owens, 2004), were embedded within the interface. These cases were drawn from relatively complex investigations that required the use of profiling techniques. All cases had all been solved previously and included a detailed profile of each offender. Concept labels identified in Study 2a (e.g., degree of intelligence) were assigned case-specific values based on the information present within the real-life cases (e.g., above average). However, only one person of interest was assigned concept values consistent with the known offender from the real-life case; the two remaining persons were assigned concept values consistent with persons of interest from the case and alternative case files. Complete versions of each scenario (including all scenario descriptions, concept label values, and crime scene graphics) are provided in Appendix M.

Consistent with Study 3a, the expert cue-based associations identified in Study 2a were used in the ACE training strategy (i.e., the desired cues to be acquired by participants). This set comprised 46 concept label pairings from the domain of offender profiling (see Appendix H). Participants received the P-CAT prior to, and following, the ACE training. The P-CAT was presented to participants on a laptop computer (LG, 17” colour monitor, ATi Mobility X1400, 1GB DDR2 667 MHz RAM) via DMDX software (Forster & Forster, 2003), which collected response latencies. The same laptop was used for all participants to maintain a consistent screen refresh rate of 16.46ms.

6.3.3.4 Procedure

The participants were randomly assigned to one of two groups. The first group received the implicit interface style; the second group received the explicit interface style, as detailed previously. Participants were supplied with a hyperlink to the online interface, and a username and password, which enabled them to log onto the system. Participants were asked to complete
two scenarios within the assessment interface. The presentation order of scenarios was counterbalanced across both conditions, for all participants.

Participants were informed that the interface was designed to assess their decision-making performance in the domain of offender profiling. Within each scenario, participants were provided a brief introduction to the investigation of a serious crime, including a caption that represented the case briefing, and a graphic designed to aid their visualisation of the crime scene. After reading the information, they were instructed to click the continue icon. Participants were then presented with left and right screens. On the left, they were presented with information describing the criminal act in either the implicit or explicit format (detailed in 6.3.3.3). On the right screen, they were presented with an interactive interface. In this interface, participants were provided a list of offender-related concept labels, which may be useful to an investigator when constructing an offender profile. By clicking on these concept labels, participants were able to view values for three different persons of interest in the case (person of interest 1, person of interest 2, and person of interest 3). For example, there was a characteristic labelled degree of intelligence. By clicking on this feature, participants were able to view information relating to the each person’s degree of intelligence (e.g., above average).

Using this information, the participants’ task was to determine which person of interest (1, 2, or 3) was most likely to be the offender in the given scenario. They were then instructed to click the continue icon. This enabled participants to move the cursor to tick the box next to the person of interest whom they believed was the offender. The interface recorded the decision made between the three persons of interest (accuracy), the duration between the accessing and closing of each concept label (time), and the sequence in which concept labels were accessed.
(information acquisition). Participants’ interaction with the interface in this instance was intended to provide a gauge of their pre-intervention profiling performance.

Following completion of the pre-intervention interface, participants were invited to complete the P-CAT (pre-training), ACE training, and P-CAT (post-training) trials (consistent with the design used in Study 3a). Upon completion, participants were again supplied with a hyperlink to the decision assessment interface (receiving the same interface style, implicit or explicit, that they were assigned originally), and a new username and password, which enabled them to log onto the system again. This ensured that direct comparisons could be made between pre- and post-intervention performance. Participants were required to complete two new scenarios within the interface. The presentation order of scenarios was counterbalanced across both conditions, for all participants. On this occasion, participants’ interaction with the interface was intended to provide a gauge of their post-intervention profiling performance.

6.3.4 Results

The analyses were divided into two sections each relating to different performance variables examined prior to, and following, the intervention (training): cue activation (P-CAT) and decision-making (decision assessment interface) performance.

6.3.4.1 Analyses

**Cue Activation (P-CAT) performance (Pre- vs. Post-Training)**

The aim of this analysis was to determine whether a difference existed in participants’ response latency in recognising associations from the expert target sample, between the pre- and post-training conditions. Participant response latencies in the P-CAT (from the point of offender-related concept presentation onset) were recorded for each concept pairing presented. All
participants who received the training condition scored greater than 80% on the pairing recall task and, thus, no participants were excluded from the post-intervention condition.

Descriptive statistics for both groups’ response latencies revealed definitive and consistent differences across the two conditions. As the differences across the conditions appeared largely consistent, it was considered unnecessary to employ a statistical test to examine whether significant differences existed for each of the 46 associations, and that further, such tests would unnecessarily increase the potential for a Type I error. Instead, participant scores for each of the 46 associations were collapsed into a grand mean for the entire expert target sample. These grand means were then compared across the pre- and post-training conditions.

A dependent samples t-test was employed to determine whether a significant difference existed between participants’ response latency for the expert cue sample prior to, and following, training. Prior to collapsing scores into grand means, screening of the data revealed 39 outliers across the 46 associations. The outliers were converted to the next extreme score, plus one (Tabachnick & Fidell, 2005). With alpha set at .05, and homogeneity of variance met, the results revealed a significant difference in the mean response latency between the pre-training (\( M = 1079.96, SD = 105.96 \)) and post-training conditions (\( M = 820.95, SD = 101.46 \)), \( t(23) = 9.80, p < .001 \). These results suggest that novice participants who received ACE training subsequently improved their recognition of expert cue-based associations in the P-CAT.

These results were consistent with those observed in Study 3a, and suggest that, like naïve participants, novice participants significantly improved their cue activation subsequent to receiving ACE training. The novices’ mean response latencies for the expert target sample, prior to, and following, training, are shown in Figure 6.8. For comparative purposes, the experts’
response latencies for the same 46 associations (as observed in Study 2a) have been included in the Figure.

![Graph showing response latency (ms) for Novices (Pre-Training), Novices (Post-Training), and Experts.]

Figure 6.8. Novices’ mean response latency (+SE) for the 46 associations (drawn from the expert target sample), prior to, and following, training. The experts’ response latencies for the same 46 associations (as observed in Study 2a) have been included for comparative purposes.

Decision Performance (Pre- vs. Post-Training)

One participant did not complete the post-training decision assessment interface. As such, the data were excluded from the analyses relating to decision-making performance. The analysis of performance for the interface was divided into three sections based on three performance variables of interest (accuracy, time, and information acquisition).

Accuracy. The aim of the accuracy analysis was to determine whether there was a difference in decision accuracy for scenarios completed within the interface prior to, and following, the administration of ACE training, for each of the implicit and explicit interface styles. Participants’ responses regarding their choice of the person of interest (out of the three
possible options) were coded as either 1 for a correct response, or 0 for an incorrect response, for each of the two scenarios, in each of the interface conditions (pre-training and post-training). This meant that participants could either attain 0, 1, or 2 correct responses in each of the pre- and post-training conditions. Participants’ pre- and post-training scores across each interface style are listed in Table 6.1. Scores on decision accuracy from the pre and post-training conditions failed to meet assumptions of normality for parametric analysis. Therefore, two separate Wilcoxon Signed-Rank nonparametric tests were used to examine differences in accuracy; one analysis for each of the interface styles (implicit and explicit).

Firstly, participants’ accuracy scores from the implicit interface style for pre- and post-training were compared using the Wilcoxon Signed-Rank test. With alpha set at .05, the results did not reveal a significant difference between the median rank for the pre-training condition (\(Mdn = 1, \text{Range} = 2\)) and the post-training condition (\(Mdn = 1, \text{Range} = 1\)), \(z(N = 11) = 1.61, p = .11\).

Secondly, participants’ accuracy scores from the explicit interface style for pre- and post-training were compared using the Wilcoxon Signed-Rank test. With alpha set at .05, the results revealed that the median rank for the post-training condition (\(Mdn = 2, \text{Range} = 1\)) was significantly higher than the median rank for the pre-training condition (\(Mdn = 1, \text{Range} = 2\)), \(z(N = 12) = 2.13, p = .03\).
Table 6.1

Participants Pre- and Post-Training Accuracy Scores across Each Interface Style

<table>
<thead>
<tr>
<th>Interface</th>
<th>Participant</th>
<th>Accuracy Scores</th>
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<tr>
<td></td>
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<td>Pre-Training</td>
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<tr>
<td>Implicit</td>
<td>1</td>
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Overall, these results indicate a significant improvement in participants’ accuracy in identifying the unknown offender subsequent to training (i.e., improvements in cue activation), for those participants who engaged the *explicit* interface style. No such improvement was demonstrated by participants who engaged the *implicit* interface style, suggesting that the participants’ ability to operate successfully in a task representative of a natural setting was limited.

*Time.* The aim of the time analysis was to determine whether there was a difference in the time taken to complete scenarios within the assessment interface prior to, and following, ACE training, across the two interface conditions. Raw time scores from each scenario were combined to yield grand means for the time spent within each condition (pre-training and post-training). Prior to performing inferential analyses, screening of the data revealed four outliers for the time taken to complete the decision. The outliers were converted to the next extreme score, plus one (Tabachnick & Fidell, 2005).

A mixed repeated measures ANOVA was used to determine whether a difference in the within-subjects variable *time* existed across the two interface conditions (pre vs. post training). The *interface style* (implicit vs. explicit) was the between-subjects variable. With alpha set at .05, and homogeneity of covariance met, the results revealed a significant difference in the mean time between pre-training ($M = 628.41$, $SD = 312.16$) and post-training ($M = 482.2$, $SD = 286.34$), $F(1, 21) = 9.59$, $p = .005$, $\eta^2_p = .414$. No effect for interface style was found, $F(1, 21) = 4.48$, $p = .237$, $\eta^2_p = .066$, nor was there a significant interaction between decision time and the interface style engaged $F(1, 21) = .683$, $p = .418$, $\eta^2_p = .032$. These results suggest a significant decrease in the time taken to complete the scenarios following training (i.e., improvements in cue activation), regardless of the interface style engaged. The mean time taken to make a decision in
both the pre-and post-training conditions, across the two interface styles (implicit and explicit), is shown in Figure 6.9.

![Figure 6.9. The mean time taken (+ SE) to make a decision in both the pre-and post-training conditions, across each of the two interface styles (implicit and explicit).](image)

Despite there being no main effect of interface style, nor an interaction between interface style and decision time, an examination of Figure 6.9 suggests that this result may have been due to potential differences in decision time at pre-test, dependent upon the interface style engaged. Consequently, an Analysis of Covariance (ANCOVA) was used to examine whether a difference existed in decision time across interface styles when participants’ pre-intervention performance was controlled. The results failed to reveal a significant difference in post-intervention performance between the two interface styles, $F(1, 21) = 3.45, p = .078, \eta_p^2 = .42$. This result suggests that even when pre-test decision time is controlled, the training strategy employed was no more successful in reducing decision time when engaging one interface over the other.
Information Acquisition. The aim of the analysis was to determine whether there was a significant difference in participants’ acquisition of offender-related information with regard to the number of concept label viewed (the total number of times offender-related information was accessed) and the number of concept labels used (the number of offender-related concepts (of 28 possible in each scenario) used), based on interface interaction prior to, and following, training, across each interface style. Scores from each of the two scenarios in each condition (pre-training and post-training) were combined to yield grand means for both the number of concept labels viewed and used in each condition.

A repeated measures ANOVA was used to determine whether a difference in the number of concept labels viewed (the total number of times offender-related information was accessed) existed across the two assessment conditions (pre-training vs. post-training). The interface style (implicit or explicit) was the between subjects variable. With alpha set at .05, and homogeneity of covariance met, the results revealed a significant difference in the number of concept labels viewed between the pre-training ($M = 72.35$, $SD = 8.16$) and post-training ($M = 55.26$, $SD = 7.60$) conditions, $F(1, 21) = 8.51$, $p = .008$, $\eta_p^2 = .30$. No effect for interface style was evident, $F(1, 21) = 1.40$, $p = .249$, $\eta_p^2 = .063$, nor was there a significant interaction between the number of labels viewed and the interface style engaged, $F(1, 21) = .148$, $p = .704$, $\eta_p^2 = .007$. These results suggest a significant decrease in the number of concept labels viewed when engaging scenarios, subsequent to training, regardless of interface style. The mean number of concept labels viewed, across the two interface styles (implicit and explicit), is shown in Figure 6.10.
Consistent with the previous analyses, an Analysis of Covariance (ANCOVA) was used to examine whether a difference existed in the number of concept labels viewed across interface styles when participants’ pre-intervention performance was controlled. The results failed to reveal a significant difference in the number of concept labels viewed during post-intervention across the two interface styles, $F(1, 21) = .06, p = .817, \eta^2_p = .38$. This suggests that even when pre-test performance is controlled, the training strategy employed was no more successful in reducing the number of concept labels viewed when engaging one interface over the other.

Next, a repeated measures ANOVA was used to determine whether a difference in information acquisition existed across the two assessment conditions (pre- vs. post-training); this time, in relation to the number of concept labels used (the number of offender-related concepts (of 28 possible in each scenario, 56 in each pre- and post-training conditions). The interface style (implicit vs. explicit) was the between subjects variable. With alpha set at .05, and homogeneity
of covariance met, the results revealed a significant difference in the number of concept labels used between the pre-training ($M = 52.96$, $SD = 8.89$) and post-training ($M = 39.39$, $SD = 12.2$) condition, $F(1, 21) = 404.10$, $p < .001$, $\eta_p^2 = .41$. No effect for interface style was found, $F(1, 21) = .154$, $p = .982$, $\eta_p^2 = .21$, nor was there a significant interaction between the number of labels used and the interface style engaged, $F(1, 21) = .79$, $p = .385$, $\eta_p^2 = .036$. These results suggest a significant decrease in the number of concept labels used when engaging scenarios subsequent to training, regardless of interface style engaged (implicit or explicit). The mean number of concept labels used, across the two interface styles (implicit and explicit), are shown in Figure 6.11.

![Figure 6.11. The mean number of concept labels used (+SE), across the two interface styles (implicit and explicit).](image)

Consistent with the previous analyses, an Analysis of Covariance (ANCOVA) was used to examine whether a difference existed in the number of concept labels used across interface styles when participants’ pre-intervention performance was controlled. The results failed to reveal a significant difference in the number of concept labels used during post-intervention
across the two interface styles, $F(1, 21) = .06, p = .817, \eta^2_p = .38$. This result suggests that even when pre-test performance is controlled, the training strategy employed was no more successful in reducing the number of concept labels used when engaging one interface over the other.

The outcomes relating to decision-making time and information acquisition suggest an overall reduction in the processing of information required to formulate a decision, subsequent to ACE training (i.e., improvements in cue activation). This suggests an overall increase in participants’ decision-making efficiency, regardless of the type of interface engaged.

### 6.3.5 Discussion

In Study 3a, a significant improvement in naïve participants’ recognition of expert cue-based associations was demonstrated. It was concluded that this improvement in cue activation could be attributed to participants’ engagement in Associated Concepts Exposure (ACE) training. The aim of Study 3b was to determine: 1) whether a significant improvement would occur in novice (naïve participants were used in Study 3a) recognition of expert cue-based associations on the P-CAT following ACE training; 2) whether a significant improvement on the P-CAT would be matched by a significant improvement in decision-making performance (assessed using a decision assessment interface) in a number of areas, including: accuracy; time; and, information acquisition; and, 3) the extent to which any improvement in decision-making performance could occur in a task which was representative of a naturalistic setting.

The results revealed a significant improvement in participants’ recognition of the expert cue-based associations in the P-CAT. Additionally, the findings demonstrated a significant improvement in decision-making performance in the decision assessment interface (in relation to accuracy, time, and information acquisition) following training. This suggests that both the associations identified using the P-CAT and the method of training used (ACE), possess a degree
of utility in improving novice decision-making performance, and may be an attractive option for skill development. However, the results also revealed that such an improvement could only be attained when the nature of the decision assessment was consistent with the presentation of the training condition (an explicit presentation of concept labels); a highly artificial representation of the operational environment. This suggests that the novice capacity to improve decision performance within a naturalistic setting subsequent to improving cue activation was limited.

A potential limitation associated with Study 3b may be the reduced representativeness of the task. Shanteau (1992a) suggests that expertise tends to be domain-specific, in that the skills of an expert are not usually (directly) transferable outside his or her domain of expertise. As such, any attempt to examine expertise should adopt a method that precisely reflects the characteristics of the task; if the task is altered, experts may no longer be experts.

The decision assessment interface used in the current study was designed to act as a surrogate for the operational environment, which would both accurately reflect the processes involved in offender profiling and offer a controlled environment and accurate method for examining participants’ decision-making performance. Although the interface fulfilled this criteria, it also resulted in a reduction in realism in regard the type of stimuli encountered by investigators (e.g., visual and auditory) information. Further, the process of profiling, which generally involves the recall of offender-related concepts from memory, was altered to reflect a decision based on recognition of these concepts, following the examination of multiple persons of interest. At its extreme, these limitations may misrepresent some processes involved in real-world decision occurrences, compromising the extent to which the results can be generalised to real-world operations.
An additional limitation may have been the lack of information obtained during novice interface engagement regarding cue-use. Although the interface recorded the acquisition of offender-related information with regard to the number of concept labels viewed and used, the study did not measure participants’ attentional processes relating to the concepts embedded within the case information (the crime-related concepts). Indeed, it may be worthwhile to record potential differences in attention management across pre- and post-training conditions by examining users’ scanning patterns. Previous findings suggest that experts are able to modulate their scanning patterns in a more flexible manner than novices, reflecting their increased sensitivity to dynamic environments, and a superior capacity to attend to meaningful information (Schriver et al., 2008).

A final limitation associated with the current study was the lack of direct comparisons of performance in the decision assessment interface across expertise. As the expert profilers were largely reluctant to participate in performance assessments, the current study was unable to make such comparisons. Future researchers may wish to compare performance variables across expertise in order to gain: 1) a further account of the differences in profiling performance across expertise (specifically within this representation of the profiling task); 2) insight into the precise differences in accuracy, time, and information acquisition, across expertise; and, 3) an indication of the remaining differences in performance between experts and novices, subsequent to novice improvements.

6.3 GENERAL DISCUSSION

Study 3 employed a form of cue-based training designed to expose novice profilers to a limited number of cue-based associations typically used by expert profilers. In doing so, it was hoped that novices may significantly improve their recognition/activation of expert associations
(as assessed by the P-CAT). In improving novice recognition of the expert cue-based associations, the study examined whether such improvements in cue activation were matched by concomitant improvements in their decision-making performance, and thus, the extent to which differences in decision-making performance across expertise may be attributed to differences in cue activation (and presumably use) across expertise.

Two phases of study were reported. The first (Study 3a) employed an experimental training program, Associated Concepts Exposure (ACE), to aid naïve participants’ acquisition of a number of expert cue-based associations. The study was designed to determine whether exposure to expert associations, in a manner consistent with the P-CAT presentation (i.e., concept pairings in the absence of contextual variables), resulted in a significant improvement in participants’ recognition of expert cue-based associations (as assessed by the P-CAT). The results revealed that a set of expert cue-based associations could be acquired by naïve participants, in a relatively short period of time and in the absence of context-driven stimuli. These findings may have implications for the design and development of future training programs, as ACE training may represent a useful, cost-effective, precursor to other forms of training, such as decision simulations and cue-based training.

The second study (Study 3b) again used ACE training to teach a set of expert cue-based associations to participants; this time amongst novice participants, who possess some degree of awareness of the operational context. This phase of study was designed to determine whether potential improvements in novice recognition of expert associations (as anticipated in Study 3b), were matched by concomitant improvements in several facets of decision-making performance, including decision accuracy, time, and information acquisition. This study also sought to
determine whether novices’ decision performance is impacted by the extent to which the decision scenarios engaged reflects a naturalistic setting.

 The results revealed that improvement in decision-making performance could only be attained when the nature of the decision assessment was consistent with the presentation of the training condition; an explicit presentation of concept labels. This suggests that the novice capacity to improve decision performance within a naturalistic setting subsequent to receiving ACE training is significantly limited. These findings have numerous implications.

 Firstly, it would appear that the current representation of the expert cue-based associations in the ACE training was not conducive to their use in a task representative of the naturalistic operational environment encountered by profilers. Indeed, although the novices acquired a number of associations, it appears that they were unable to use them effectively in the implicit interface. As the implicit and explicit interfaces only differed in their representation of the crime-related information, this inability was most likely due to a failure to recognise the crime-related concepts of interest in a scenario that presented naturalistic, case-specific features. Consequently, it might be suggested that participants’ were unable to construct an appropriate mental model for a given situation (Klein et al., 1995). For example, participants may have been unable to recognise case-specific situational features, such as handcuffs, duct tape, and gloves, as belonging to concepts, such as the offender’s level of organisation. This would suggest that any training that attempts to expose learners to cues needs to expose them to the concepts as they would appear in naturalistic environments. For example, Wiggins and O’Hare’s (2003) Weatherwise training program introduced trainees to weather-related cues through the presentation of real images of in-flight weather conditions. Case-specific information pertaining to the cues was then accessed by dragging a cursor over various features within the image. The
findings revealed that exposure to this type of training resulted in an improvement in the timeliness of decisions regarding potential deteriorations in weather conditions. Thus, future studies may wish to employ: 1) naturalistic, visual representations of specific environmental features in the P-CAT and decision assessment interface; and/or, 2) a further stage of training prior to ACE, whereby trainees are exposed to the features that may represent the concepts presented in the P-CAT.

Although participants were limited in their capacity to recognise concepts in scenarios reflecting the naturalistic environment, when this information was embedded in concept labels (explicit interface) consistent with those used in the ACE program, they were able to use this information to navigate a decision scenario and improve upon their pre-intervention performance. In this sense, although ACE was designed solely to improve performance on the P-CAT task, participants were able, to some extent, to generalise the task-specific skills acquired during training to a related task. This is most likely due to the fact that the ACE program incorporated elements identical to the explicit interface (i.e., concept labels), as ‘transfer of skill’ is said to be maximised when stimuli are identical (Thorndike & Woodworth, 1901).

Overall, novice improvements in decision performance in the explicit assessment interface highlights two critical findings: 1) differences in cue activation (and presumably use) appears to, in part, differentiate decision performance across expertise (discussed in greater detail in the general discussion); and 2) the expert cue-based associations identified in Study 2 were relatively valid, supporting the use of the P-CAT within the knowledge elicitation process. This finding has implications for embedding critical cue inventories within cue-based training programs and Decision Support Systems (DSS).
Finally, the findings suggest that decision performance may be improved, in some conditions, through the acquisition of singular concept to concept associations. Although this suggests the application of cues as rule-based productions, it is argued that this is not an accurate reflection of expert cue-use in naturalistic environments. Indeed, in real-world environments, cues may exist as components of complex systems or correlated relations.

In information processing models, co-correlated cues, which are “the co-occurrence of cues in perception” (Wickens & Hollands, 2000, p. 308), play a major role in decision-making. These correlated cues form patterns, which are recognised without consideration of single, separate cues, reducing the cognitive resources necessary to manage information. Here, one cue (e.g., high intelligence) may be more likely to occur in the presence of another (e.g., high organisation). The presence or absence of additional cues, in combination, will form complex variable patterns in real-world scenarios. Thus, proficiency may be based, in part, on the decision-maker’s capacity to recognise familiar patterns, or correlations, of cues, which may lead to the retrieval of schemas or mental models in long-term memory.

The use of cue correlations across expertise was examined by Stokes et al. (1992) who found that expert pilots outperformed novice pilots on a memory-intensive in-flight decision-making task, but failed to do so on more domain-general measures. Stokes et al. suggested that the experts were able to rapidly match current information with pre-existing schemas that were represented by correlated cues. In contrast, novice pilots considered each cue individually, rather than integrating their combined meaning, thereby increasing the potential for misdiagnosis, and causing greater demands on cognitive resources. Likewise, Bellenkes et al. (1997) examination of flight controllers’ scanning patterns revealed that experts better utilised the correlation of instrument variables on the flight deck panel compared to non-expert controllers.
Correlated information is very common in the domain of offender profiling (Mokros & Alison, 2002). In fact, it could be argued that the use of correlated cues during profiling may act as a type of heuristic, which enables a profiler to rapidly diagnose offender-related features. For example, the use of an organised/disorganised management strategy is a popular dichotomy within the practice of criminal investigative analysis, a profiling method commonly employed by the Federal Bureau of Investigation during the investigation of violent crimes (Canter, Alison, Alison, & Wentink, 2004). As its name suggests, the dichotomy offers two categories of offender typology, organised or disorganised. Each typology has a set of highly correlated cues. By using this simple heuristic, a profiler may diagnose an offender typology (and subsequent profile) based on a minimal number of cues. For example, the observation of destruction of evidence at a scene falls into the organised offender typology. From this limited piece of information, many profilers will infer information regarding other offender features which also fall into this typology, such as above average intelligence, skilled employment, long-term relationship, etc (Alison, Bennell, & Mokros, 2002). However, like other simplistic heuristics, the use of the organised/disorganised dichotomy can lead to an increased potential for error in diagnosis. For example, the FBI profile of the Washington D.C Sniper identified the presence of cues indicating an organised offender, and from this information, indirectly, and incorrectly, diagnosed the offender as Caucasian (Rossmo, 2008). An illustrated example of the organised/disorganised dichotomy (adapted from Alison et al., 2002) is provided in Figure 6.12.
Figure 6.12. An illustrated example of the organised/disorganised dichotomy (adapted from Alison et al., 2002).

As the Washington D.C Sniper case suggests, the presence and/or absence of cues, in concert with one another, is critical to accurate diagnosis. Slight variations in cue combinations have the potential to alter a cue’s meaning entirely. For example, the concept *social competency* may often share an association with the *method of approach* used by the offender; however, the additional feature *relationship with victim* may void this association and indicate something else entirely. Further, these relations will hold different weightings, similar to neural models (Bishop, 1995), which are dependent on the specific cue *value* in the given scenario. For instance, the
concept intelligence may share an association with different concepts depending on its specific value within a case; below average intelligence will most likely indicate something different to the observation of above average intelligence.

The prevalence of cue correlations was also supported by qualitative reports from subject matter experts consulted during testing for Studies 1 and 2. Numerous experts stated that, in many cases, they were able to recognise familiar patterns in both the crime- and offender-related features, which enabled them to formulate their diagnosis. The high degree of relatedness between cues is also evident when considering the degree of shared activation amongst cues (crime-related concepts) in the expert target sample. A concept map which depicts the degree of shared activation amongst cues (crime-related concepts) from the expert target sample is provided in Figure 6.13.

Although the validity of the cues used in the current form of training is well established, perhaps a way to improve trainees’ decision performance in naturalistic settings would be to promote their acquisition of multiple levels of potential association. As trainees’ capacity to recognise cue correlations most likely develops as a consequence of both task engagement and feedback in relation to decision outcomes, future approaches may seek to investigate the merit of a feedback mechanism during both training and assessment conditions. Indeed, the use of feedback in decision-making tasks has proven to be the most salient determinant of learning performance (Balzer, Doherty, & O’Connor, 1989).
Figure 6.13. A concept map which depicts the high degree of shared activation amongst cues (crime-related concepts) from the expert target sample.
Alternatively, the current approach to cue-based training may be extended to promote the acquisition of strong associations not only between, but also *amongst*, crime and offender-related concepts; enabling novices to acquire both valid cue-based associations *and* their correlations with other cues and associations. By doing so, operators may begin to develop broader networks of cue-based associations, or schemas, which may aid in their diagnosis of a situation (Klein, Moon, & Hoffman, 2006).

A factor of Study 3 that could be perceived as a limitation was the guidance/restriction of participants’ information acquisition process when comparing the persons of interest in the decision assessment interface. The interface used was designed to reflect a method of information management that less experienced decision-makers have demonstrated a preference for, in numerous domains (e.g., forensic investigations (Morrison et al., 2010); aviation (Wiggins & Bollwerk, 2006); and fire-fighting (Perry et al., 2009)). However, it should be noted that expert decision-makers tend to be more judicious than their novice counterparts in both the acquisition and the integration of information during decision-making (Hutton & Klein, 1999; Shanteau, 1992b). As a result, in many instances, expert decision-makers will have developed sophisticated heuristics that are designed to balance the demand for accuracy while minimising cognitive load (Payne et al., 1988). Consequently, it might be suggested that expert decision-makers are more likely to engage a suitable heuristic given the demands of a particular task, the demands associated with the heuristic, and the information available to the decision-maker (Morrison et al., 2010). As such, although the awareness of valid cue-based associations may be beneficial to trainees, it could be argued that the progression towards expert performance will most likely also require the capacity to apply different heuristics in different situations. Indeed,
as Dawes and Corrigan suggest “The whole trick is to decide what variables to look at and then know what to add and how to manage them” (1974, p.105).

6.4 CHAPTER SEVEN BRIEF

The following chapter will present a general discussion in relation to the thesis findings, conclusions, limitations, recommendations for future research, and implications.
Chapter 7

GENERAL DISCUSSION:
A SUMMARY OF THE THESIS FINDINGS,
GENERAL CONCLUSIONS, LIMITATIONS,
RECOMMENDATIONS FOR FUTURE
RESEARCH, AND IMPLICATIONS
“He possesses two out of the three qualities necessary for the ideal detective. He has the power of observation and that of deduction. He is only wanting in knowledge; and that may come in time.”

- Sherlock Holmes, in “The Sign of the Four”
7.1 **CHAPTER OVERVIEW**

The following chapter presents a general discussion of the thesis findings, general conclusions, limitations, recommendations for future research, and implications.

7.2 **THESIS FINDINGS**

This thesis adopted the naturalistic decision-making approach to theory and research (outlined in Chapter One) to examine a specific cognitive component of decision-making, cue-use, and examine how this process may differentiate performance across expertise. Specifically, the aim of this thesis was to investigate potential differences in cue activation (and presumably use) across two stages of expertise (expert and novice), and to determine whether it is possible to improve novice decision-making performance based on a modelling of expert cue activation.

The project involved three studies, the first of which (Study 1) employed an interview strategy based on a revised version of the Critical Decision Method (CDM) (Klein et al., 1989), which allowed for the analysis of real-time decisions made by the interviewee (i.e., a Real-Time CDM). Specifically, the strategy involved the presentation of pre-selected critical incidents to both expert and novice profilers. The interviewer then used a set of cognitive probes designed to elicit information, in real-time, in relation to the decision processes engaged by the interviewee when encountering the incidents. This technique used a combination of think-aloud and concurrent probing techniques to examine specific instances of cue-use. By using this revised version of the CDM, participants were not required to generate incident descriptions from memory, making it possible to examine the decision processes engaged by interviewees with differing levels of expertise when approaching the same task.

The aim of Study 1 was to identify a number of potential concepts of interest as used by two classes of profile: expert and novice. This study had three specific aims: firstly, to identify a
number of feature descriptions that profilers target in an operational environment (potential
cues); secondly, to identify a number of feature descriptions relating to an unknown offender,
that profilers retrieve from memory when cued; and, finally, to collapse these two groups of
feature descriptions into concept labels, which represent the potential cues used (crime-related
concept labels) and the associated concepts (offender-related concept labels) retrieved from
memory. These concept labels were to be used as a basis for discriminating between expert and
novice cue activation (and presumably use) using an adapted paired association task (detailed in
Study 2).

The findings of Study 1 revealed that both groups of participants (experts and novices)
demonstrated a capacity to identify a range of features of interest to the profiling process. From
these data, a large number of crime-related and offender-related concepts labels were identified
via content and thematic analyses.

Study 2 was designed to discriminate between expert and novice cue activation in the
context of offender profiling, using an adapted paired association task. Two phases of study were
reported, the first of which (Study 2a) presented pairs of concept labels (identified in Study 1) as
part of a Paired-Concept Association Task (P-CAT) which recorded participants’ response
latency in recognising associations (cue activation). This task was designed to objectively
measure the relative strength of associations between cues and the concepts that may be retrieved
from memory, across expertise level. Specifically, the P-CAT was used to distinguish between
expert and novice cue activation in terms of: (1) the level of consistency with which concepts are
associated within groups; (2) the types of concept relations that are perceived to be most related;
and (3) the response latency in responding to concept pairings. In doing so, it was anticipated
that the findings would yield a number of cue-based associations that are predominantly used by expert decision-makers and that may be embedded in a cue-based training system.

The second phase (Study 2b) involved the distribution of a survey to further test participants’ perceptions of the associations between concepts. The survey was used to explore the basis of the expected differences in response latency by examining expert and novice perceptions of frequency of use, strength, domain specificity, and diagnosticity, of a number of associations recognised by each respective group (expert and novice).

The outcomes of Study 2 revealed that the P-CAT could accurately discriminate between expert and novice cue activation in the context of offender profiling based on agreement and response latency. On this basis, the P-CAT was proposed as a new method for objectively validating an inventory of expert cue-based associations previously extracted using an interview technique. Further, it was established that expert participants’ perceptions of the cues reflected their response latencies in that the shorter the response latency when recognising an association, the greater the perceived activation, strength, domain specificity, and diagnosticity of the association. In contrast, novices’ perceptions did not differentiate the two types of association, suggesting that the ability to discriminate between stimuli consistently is, indeed, a function of expertise (Shanteau, 1992a). Overall, the findings suggest that key differences in cue activation (and presumably use) exist as a function of one’s level of expertise and that these differences can be distinguished using a response latency-based task such as the P-CAT.

Finally, Study 3 employed a form of cue-based training designed to expose novice profilers to a limited number of cue-based associations typically used by expert profilers. As a result of this exposure, it was expected that novices would significantly improve their recognition/activation of expert associations (as assessed by the P-CAT). In improving novice
recognition of the expert cue-based associations, the aim was to determine whether such improvements in cue activation were matched by concomitant improvements in decision-making performance, and thus, the extent to which differences in decision performance across expertise may be attributed to differences in cue activation (and presumably use) across expertise.

Two phases of study were reported. The first (Study 3a) employed an experimental training program, Associated Concepts Exposure (ACE), to aid naïve participants’ acquisition of a number of expert cue-based associations. The study was designed to determine whether exposure to expert associations, in a manner consistent with the P-CAT presentation (i.e., concept pairings in the absence of contextual variables), resulted in a significant improvement in participants’ recognition of expert cue-based associations (as assessed by the P-CAT).

Two tools were used in Study 3a. Firstly, a training tool designed specifically for this study, the ACE training program, was used to expose naïve participants to a set of expert cue-based associations (as identified in Study 2a). Secondly, to assess pre- and post-training cue activation, the previously used (Study 2a) P-CAT was employed. The commencement of Study 3b was contingent upon the success of the ACE training program improving naïve participants’ recognition of the expert cue-based associations (i.e., their cue activation) in the P-CAT.

Study 3b again used ACE training to teach a set of expert cue-based associations to participants; this time to novice participants, who possessed some degree of awareness of the operational context. This phase of study sought to determine whether potential improvements in novice recognition of expert associations, were matched by concomitant improvements in several facets of decision-making performance, including decision accuracy, time, and information acquisition. This phase also sought to determine whether novice decision performance was impacted by the extent to which the decision scenarios engaged reflected a naturalistic setting.
Three tools were used in Study 3b: the ACE training program; the P-CAT; and, a decision assessment interface. The decision assessment interface operated as a surrogate for the operational environment, enabling users to explore, acquire, and integrate cue-based information in quasi-realistic profiling decision tasks. The interface was used to assess participants’ decision performance, including performance variables such as decision accuracy, time, and information acquisition. The interface was administered prior to, and following, ACE training.

The outcomes of Study 3 revealed that a set of expert cue-based associations could be acquired by both naïve and novice participants, in a relatively short period of time, and in the absence of context-driven stimuli, using ACE Training. Moreover, exposing novice profilers to a set of expert cue-based associations improved their decision-making performance in a profiling decision task. However, the results also revealed that such an improvement could only be attained when the nature of the decision assessment was most consistent with the presentation of the training condition; a highly artificial representation of the operational environment. This suggests that the novices’ capacity to improve decision-making performance within a naturalistic setting subsequent to improving cue activation is limited.

7.3 GENERAL CONCLUSIONS

The outcomes of this thesis offer insight into the role of cue-use in the development of decision-making expertise. Although it is clear that the novices who participated in these studies did not develop into experts, this was never the aim of the research. Instead, the research was designed to examine whether improvements in cue activation (and presumably use) lead to comparable improvements in decision-making performance.

On the basis of the results, it would appear that, although the novices’ were able to improve their decision-making performance to some extent following the acquisition of expert
cue-based associations, their ability to recognise and employ these associations in a task representative of a naturalistic decision scenario, appears to be dependent, ultimately, on other task-specific cognitive skills that develop as a result of operational experience, such as a decision-maker’s capacity to construct mental models in response to case-specific variables present in a given situation. Indeed, experts have been shown to be capable of constructing hypothetical mental models relating to familiar decisions, in regard potential changes in the system state, threats and opportunities that may result, and potential options and their projected outcomes (Klein et al., 2006). Experts construct these mental models based on connections between people, places, events, and features in an attempt to anticipate future developments to respond to a situation (Klein et al., 1995). This proposition is supported by Bellenkes et al. (1997) who demonstrated that expert pilots were able to construct mental models based on previous cases, and use these mental models to target relevant environmental cues. Thus, it would appear that the targeting of familiar cues during decision-making may not necessarily direct the decision-maker to the right decision, but instead, as Klein (1998) alludes to, the ability to recognise a familiar decision may direct the decision-maker to the right cues.

Although the participants involved in the current research developed some level of awareness of the key associations involved in the domain – who, what, when, and where – their capacity to recognise meaning within a bounded context, and the strategies and limitations involved during a profiling task, appears to have remained limited. Accordingly, it would appear prudent that cue-based training programs be administered to operators who have reached a level of competency, who may, based on their exposure to previous cases, be able to construct mental models that may guide their selection and interpretation of cue-based information.
Overall, the current findings suggest that, although the acquisition of valid cue-based associations is vital to the development of expertise, a cognitive gap remains between expert and novice performance that cue-use alone cannot account for. Ultimately, the key to closing this gap appears to hinge on a number of additional cognitive skills (e.g., the construction of mental models), which many decision-makers will most likely acquire as a result of extensive domain-specific operational experience (Klein, 1998).

7.4 LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The primary limitation of each of the three studies in this thesis was the predominant use of text-based descriptions to represent cue-based information. A decision-maker will most likely use an array of media in the environment. For instance, a profiler will scan a scene for visual evidence such as blood spatter and, for the same case, listen to witness statements (Hazelwood et al., 1995); a combination of auditory and visual information. By not representing some information as it may be found naturally in the operational environment, the use of text-based stimuli may have limited the ecological validity of the current findings. Future studies may seek to explore alternative representations of cue-based information to determine whether information presentation impacts recognition. For example, future researchers may choose to modify the P-CAT to include more naturalistic representations of the concepts (e.g., crime scene graphics).

Similarly, although the training system used in the thesis yielded a number of positive outcomes, assessment was based on a simulated profiling task. The extent to which performance on a simulated task reflects performance on the actual task is a contentious issue. For instance, Shanteau (1992a) proposes that any attempt to examine expertise should adopt a method that precisely reflects the characteristics of the task. However, it should be noted that the simulated
profiling task was based on real crime-related scenarios and variables, and also, that practical and ethical considerations precluded exposing novice participants to real investigations.

Future research should also seek to address the limitations associated with the initial stages of knowledge elicitation (see Study 1), which typically involve some form of qualitative technique (e.g., Critical Decision Method; Klein et al., 1989), and consequently, a significant degree of experimenter judgement and interpretation during analysis (Burnard, 1991). Although the potential confounds associated with this form of analysis may be limited by ensuring an acceptable level of inter-coder reliability (Conrad & Blair, 2004), there still exist two concerns with this method of knowledge elicitation. Firstly, there is a concern that the feature descriptions gathered using qualitative techniques may not be representative of the task. This could be due to the fact that responses reflect a rationalisation of the cognitive processes that occur, rather than an accurate reflection of the decision-making process. Secondly, there is a concern that the feature descriptions may be misinterpreted as a result of coder judgement. Considering these concerns, future researchers might investigate the use of tasks that aim to recreate the user’s interaction with the operational environment. For example, the use of virtual environments combined with the use of online methods which attempt to capture real-time indications of cognitive processes, such as eye-tracking (Seagull & Xiao, 2001; Wiggins, 2007), may offer a more objective indication of the environmental features of interest.

Finally, the results suggest that operational experience alone cannot guarantee the acquisition of the cognitive skills necessary to become an expert. As such, future research should examine individual differences across decision-makers to better understand the underlying cognitive factors that differentiate proficiency from true expertise (Smeeton, Williamson, Hidges, & Ward, 2005). For instance, there is evidence to suggest that despite the acquisition of
skills, some operators demonstrate a failure to progress to an expert level of proficiency, despite a significant accumulation of previous operational experience (Gray, 2004; Lany, Gomez, & Gerkin, 2007).

7.5 IMPLICATIONS

The following section will outline several implications in relation to a number of key areas explored within the thesis, including: knowledge elicitation strategies, cue-based training, offender profiling, and the naturalistic decision-making paradigm.

7.5.1 Knowledge Elicitation Strategies

The identification of cue-based associations commonly engaged by expert decision-makers in their respective domain is an attractive avenue for skill development. Such an inventory may be used to improve decision-makers’ real-world performance in advanced technology environments (e.g., decision support systems), and/or, aid in the acquisition of task-specific cognitive skills (e.g., cue-based training programs). However, the potential selection of ineffective or inappropriate cue-based information, which may ultimately result in deterioration in performance, highlights the importance of the knowledge elicitation process and the identification of valid and reliable cue-based information.

A number of different methodologies have been developed to elicit cue-based information from subject-matter experts. Although a limited number of studies have sought to identify expert diagnostic cues using on-line tasks such as eye-tracking (Seagull & Xiao, 2001), the vast majority of studies have used off-line, qualitative techniques, from which cues are extracted using a subjective coding process. Generally, this is due to the fact that, unlike eye-tracking, interviewing techniques provide insight into a range of cues across perceptual domains.
(Hoffman, Coffey, Carnot, & Novak, 2002). Nevertheless, current elicitation techniques are the subject of considerable criticism.

One of the criticisms associated with knowledge elicitation strategies concerns the extent to which the outcomes are both valid and reliable. For example, in the case of retrospective verbal protocol analysis, there has been some concern as to whether the outcomes of this process reflect a rationalisation of behaviour, rather than an accurate reflection of the cues that were engaged during the process (Kusela & Paul, 2000). A similar concern might be levelled in respect of the cognitive interview, particularly where the stimulus for the recollection of events occurs some time prior to knowledge elicitation (Bekerian & Dennet, 1993). As a result, there is a need for a method that will validate the cues extracted as valid and reliable markers of those features that are engaged during the performance of the task.

While there have been some attempts to validate the cues extracted through interview, these have been restricted largely to the administration of surveys in which participants indicate independently, their application of particular cues. The current thesis proposed the measurement of relative conceptual associative strength as a means of validating an inventory of cue-based associations extracted using a qualitative interview strategy. By measuring participants’ response latency in recognising/activating cue-based associations, the current research revealed that experts were, as a whole, more consistent than novices in their assessment of concept relations. Experts also appeared to activate different associations compared to their novice counterparts. Further, experts’ response latencies were significantly shorter than novices’ response latencies on the associations that experts recognised most consistently and rapidly.

On the basis of these results, the P-CAT proved successful as an objective means of gauging the relative strength of cue-based associations, and, consequently, led to the
identification of a number of associations that appear to be used frequently by expert profilers, and less frequently by novice profilers. The proposed relationship between response latency and cue utility was further supported by participants’ perceptions of the associations. Overall, it can be concluded that the P-CAT accurately discriminates between expert and novice cue activation (and presumably use) in the context of offender profiling and, therefore, offers a new method for objectively validating cue inventories, originally extracted using qualitative techniques.

7.5.2 Cue-Based Training

Cue-based training commonly takes two forms, the first of which is based on the notion of cue discovery (Klayman, 1988). These methods involve the intended acquisition of cues during some form of simulation of the relevant operational environment. Generally, through interaction with a scenario, it is presumed that users will spontaneously recognise relationships between concepts, and hence, identify the appropriate cues to engage. For example, Klayman observed that enabling learners to discover the cues associated with a task resulted in subsequent improvements in the learner’s ability to predict the behaviours of a computer-controlled graphic display.

Although cue discovery training allows the trainee to acquire meaningful cues in a task representative of the operational environment, many organisations do not possess the time, nor the resources, to enable trainees to progress from novice to expert through the simulation of operational experience. As such, other forms of cue-based training have attempted to speed trainees’ acquisition of expert-oriented knowledge.

The second form of cue-based training involves promoting the trainee’s awareness of task-relevant cues (Zsambok & Klein, 1997). Here, trainees are supplied with a pre-identified number of presumably valid cues (generally identified through cognitive interviews with
experts), which they must engage to navigate a decision scenario. Consistent with cue discovery, this form of training generally involves some level of simulation or critical decision to be resolved by the trainee. For example, Wiggins and O’Hare (2003) developed a computer-based training system designed to enable pilots to respond to critical cues associated with deteriorating weather conditions during flight. Case-specific information pertaining to the cues was accessed by dragging a cursor over various features within weather-related images. Subsequently, participants were asked to identify the point at which weather conditions deteriorated to an unacceptable level.

The aim of this type of training has been to expose the learner to cues that are useful as triggers for diagnosis. However, while this form of training has been found useful for improving novices’ attention management skills (Fisher & Pollatsek, 2007), the capacity for trainees to trigger meaningful associations in memory remains limited (Beilock et al., 2002), potentially reducing the advantages associated with expert cue use in reducing the demands on working memory (Wickens & Hollands, 2000).

Although it is consistent with the principles of this form of cue-based training, the current work extended this approach by not only exposing learners to expert cues (i.e., improving cue selection), but also exposing them to a limited number of expert associations between cues and other relevant concepts, typically triggered during expert decision-making. Indeed, the current thesis proposed and tested a third form of cue-based training based on the modelling of expert cue activation: Associated Concepts Exposure (ACE) training.

Using the crime → offender conceptualisation of offender-profiling cue-based associations, trainees were presented with a number of pre-identified conceptual associations used frequently by experts (as validated via the P-CAT). ACE training differed from the
aforementioned forms of training (cue discovery and cue awareness) in two ways. First, although it was based on the presentation of a critical cue inventory as commonly used in other forms of cue-based training, ACE training explicitly provided the trainee with both a representation of the cue and an associated concept. Thus, by exposing novices to cue-based associations, it was argued that a degree of meaning was provided to the user. Secondly, as ACE training was designed to improve cue activation alone, associations were presented in the absence of a context, simulation, or a required decision.

The findings revealed that exposing novice profilers to a set of expert cue-based associations could improve their decision-making performance in a profiling decision task. Thus, although previous attempts to develop computer-based training systems have largely focussed on the development of procedural and perceptual-motor skills among users (Koonce & Bramble, 1998), it is apparent that computer-based training systems also have the capacity to develop task-specific cognitive skills such as cue recognition in order to improve decision performance (Wiggins & O’Hare, 2003; Marinelli, 1994).

Despite these generally positive outcomes, the findings also revealed that novice profilers were unable to improve their performance on tasks which were highly representative of a naturalistic operational setting, limiting the generalisability of the outcomes to real-world applications. Indeed, it is posited that the ability to perform successfully in such environments is partly dependent on other factors, including: 1) the ability for users to construct mental models of a task (Klein et al., 1995); 2) the representation of cue-based information used during training (Wiggins & O’Hare, 2003); and, 3) the users’ capacity to interrogate not only single cue-based associations, but also cue correlations (Stokes et al., 1992).
Future training program designers may seek to extend the current approach to cue-based training adopted in this work by: 1) providing the trainee with an indication as to how the cues and their associated concepts are represented in the natural environment (Wiggins & O’Hare, 2003); 2) providing the trainee with an indication of cue value in a broader network of relations (Stokes et al., 1992); 3) developing the skills of trainees who already possess a capacity to construct mental models (i.e., competent operators); and, 4) providing the trainee with feedback in relation to assessment outcomes (Balzer et al., 1989).

Considering these recommendations, future studies may seek to adapt the decision assessment interface used in Study 3 as a surrogate for the profiling operational environment, into a training simulation device which incorporates a performance feedback mechanism. Such an initiative may offer a form of training that supplements the cue-based knowledge attained during training programs such as ACE with a degree of domain-specific operational experience.

7.5.3 Offender Profiling

Although the practice of offender profiling served as a context for studying cue-use in decision-making, several noteworthy implications for the domain are outlined.

Offender profiling or more simply, profiling, is a rapidly emerging practice that involves the application of psychological principles regarding human behaviour to the investigation of a criminal act (Canter, 2000). As an investigative tool, profiling holds the promise of effectively narrowing a vast population of suspects by offering a description, a compilation of both physical and psychological characteristics (e.g., age, sex, marital and employment status, personality type, etc.) of the unknown offender in question, based on inferences drawn from his or her physical, sexual, and, in some cases, verbal interaction with his or her victim(s) (Davis, 1999; Douglas et al., 1992; Wilson et al., 1997).
Although the practice of profiling has expanded to include new functions, such as predicting an offender’s geographical location (Canter & Gregory, 1994), anticipating hostage scenario outcomes (Woodworth & Porter, 1999), and assessing letters of threat (Wilson et al., 1997), the majority of profiling practices are concerned with the investigation of violent crimes (Holmes & Holmes, 1996). Indeed, profiling has been found to be particularly useful in cases of violent sexual homicide where there is both a difficulty to identify motive, and pressure to apprehend the offender as quickly as possible (Canter, 2000).

Numerous profiling techniques, ranging from intuitive to analytical methods, are employed by law enforcement agencies throughout the world (Kocsis et al., 2000). Despite its prevalence, Coleman and Kocsis (2000) observed that the practice of profiling, in most countries, is not regulated by any authority that promotes a code of best practice. Further, the practice has been criticised by the American Psychological Association for the lack of reliability and scientific rigor inherent in some profiling methods (Jeffers, 1992). Ultimately, these factors have resulted in a degree of scepticism regarding profiling amongst some law enforcement agencies. For example, Holmes and Holmes (1996) observed that an offender profile was usually only requested when the police had exhausted all other leads, which sometimes included psychics and astrologers. The scepticism surrounding the profiling process is probably the result of the lack of scientific validity associated with the practice, compared to other forensic techniques such as DNA and fingerprint analysis (Turvey, 1999).

Ultimately, the lack of empirical evidence relating to the validity of profiling has contributed to the perception that profiling is more *art* than *science* (Turvey, 1999). Indeed, there exists a growing public perception that the profiling process is one based on *psychic powers*; a view that has been perpetuated by popular fictional television shows such as *Profiler,* which
follows a psychic detective working with the FBI (Muller, 2000). Ultimately, this perception of profiling has raised questions over the legal right of investigators to pursue, apprehend, and interview a suspected perpetrator based on a profile (Odgers & Richardson, 1995).

To validate the use of profiling techniques within the investigative process, it would seem necessary to first identify the most valid and reliable form of profiling. Unfortunately, gauging profiling performance has proven problematic for two reasons. Firstly, there exists reluctance by renowned profilers to undertake performance tests. For example, Copson, Badcock, Boon, and Britton (1997) noted that profilers tend to exhibit a significantly strong sense of professional rivalry and, consequently, are very hesitant to admit any limitation in their abilities. Secondly, there is no one profiling method (Woodworth & Porter, 1999). There exists a range of (often contrasting) profiling philosophies based on different learning and practice backgrounds, and a lack of understanding across these practices (Kocsis et al., 2000). For example, pure investigative approaches often deny the relevance of psychological principles within their practices, even though the investigation of violent crimes often involves a psychologically aberrant offender (Kocsis, 2003). This reluctance by law enforcement to consult other sources of expertise is most likely due to the insular organisational culture evident within many law enforcement agencies (Chan, 1996). The thesis findings offer further insight in regard to the validity of profiling techniques.

Firstly, consistent with Copson et al.’s (1997) observations, there was a great reluctance by experienced profilers to participate in the studies relating to this thesis. Indeed, of the 36 profilers/profiling organisations contacted, 26 (72.2%) declined, or did not respond to the invitation to participate. This reluctance was observed, even though participants were not assessed on their profiling capabilities per se (i.e., they were not assessed on their capacity to
predict an unknown offender), and further, they were assured of complete anonymity. Although professional rivalry might have been a contributing factor (Copson et al., 1997), the vast majority of prospective participants declined participation based on their belief that the profiling process could not be studied in any meaningful way using psychology.

Again, this reluctance demonstrates the unwillingness of profilers to engage in scientific research. Unfortunately, this further perpetuates the perceived lack of validity/reliability associated with profiling methods. Although offender profiling represented a relatively complex context that encapsulated a broad range of associations, future studies may seek use other domains, which may offer a greater opportunity to observe expert decision-making performance.

Secondly, in light of the contrasting techniques evident in the field of profiling, the current thesis involved recruiting profilers from a range of backgrounds, including Criminal Investigative Analysis, Geographical Profiling, Investigative Psychology, Criminology, and Cognitive Behavioural Psychological Profiling. Although the experts were drawn from these differing backgrounds, the consistency with which the experts agreed on the existence of an association within the P-CAT was relatively high (88.8-100% agreement in the top portion of the associations). This finding demonstrated a high level of agreement amongst expert profilers in regard the existence of relationships between crime- and offender-related concepts. This suggests that learning and training backgrounds may be secondary to the acquisition and application of cognitive skills in a domain and, ultimately, that there are consistent cognitive processes engaged by expert profilers, regardless of the specific technique used. Unfortunately, the sample of expert profilers in the current thesis was too small to warrant a comparative analysis based on profiling techniques; however, this may be an interesting avenue for future research.
Perhaps the most interesting profiling-related finding to emerge from this work was that the use of expert profiling cue-based associations improved novices’ ability to identify an unknown offender. The identification of valid and reliable profiling cue-based associations suggests some degree of behavioural consistency across offences and stable relationships between configurations of criminal behaviours and offender features; suggesting that profiling may be a worthwhile practice in the investigation of violent crimes.

A potential application of these findings is the use of the expert profiling cue-based associations in decision support systems. Such a cue-set may enable users to reduce a vast population of potential offenders to a limited number based on the occurrence of key features of interest. Although, in many senses, the profiling process reflects a deductive method, it may be worthwhile to incorporate an inductive element into profiling DSS, whereby the user is offered probability ratios in relation to the occurrence of a feature given the variables in the decision scenario (Canter et al., 2004). For instance, in cases of serial murder within the United States, the offender will be of Caucasian appearance in approximately 84% of observations, and male in 90% of observations (Hickey, 1991). Such a design feature may allow a DSS to limit the number of options (suspects) for the user to deliberate, and ultimately, improve decision accuracy and efficiency.

7.5.4 Naturalistic Decision-Making Paradigm

In the context of decision research, the emergence of the Naturalistic Decision-Making (NDM) movement has represented something of a watershed. Rather than conceptualising decision-making as a cognitive process that is open to error, naturalistic decision theorists seek to identify those aspects of real-world decision making that enable accurate and efficient outcomes.
(Klein, 2008). As such, NDM research focuses on the identification of decision processes engaged by expert decision-makers in their domain - i.e., how do people make good decisions.

The current thesis adopted the naturalistic framework of decision research and theory, in that there was an attempt to observe and understand the specific cognitive strategies employed by experts when making decisions, and use these strategies as a model for improving novice performance. However, the current work sought to improve upon the traditional naturalistic methods that are used to observe and extract information regarding the application of cognitive skills.

The methods employed in the thesis were not intended to move the naturalistic researcher from the operational (naturalistic) environment and into the laboratory; indeed, the observation of decision behaviour in naturalistic settings appears to be vital to successful decision-making research (Klein, 2008). Instead, the thesis intended to observe these decision processes in additional and novel ways compared to previous approaches, which have traditionally relied on variations of interview as the sole form of knowledge elicitation. Indeed, the P-CAT, ACE Training, and the Decision Assessment Interface initiatives introduced in this body of work offer novel and relatively objective methods for eliciting knowledge from experts, aiding in cue acquisition, and observing decision-making processes. Together, these initiatives offer the naturalistic researcher a new collection of tools for observing the decision-making process. The intention here is not to replace naturalistic observational techniques like the Critical Decision Method (Klein et al., 1989), but instead, compliment these existing techniques by offering a greater degree of experimental control which may ultimately enrich research findings, whilst staying true to the naturalistic decision-making paradigm.
REFERENCES


*Managerial and Decision Economics, 1*(5), 317-325.


APPENDICES
Appendix A

Scenario 1

Criminal Act Event

Criminal act/Crime scene

An 11 year-old girl was walking home from her local shops at dusk. She was reported missing at 6.45 pm. Her body was found by her uncle, in plain view, at the bottom of a steep hill adjacent to the street that connects with the local shops. She is lying face down; her shorts and underwear have been removed as well as her shoes. However, her t-shirt has been left in place. Her shorts were found approximately 3 metres (9.8 feet) away in a dense patch of weeds and long grass. Her underwear has been left around her neck. Her face has been bruised with several contusions around her mouth area. She has several abrasions over her arms and legs. No restraints were present. Although the area is fenced off, there is a hole in the fence that the local children often use for a short cut. The border to the next neighbouring town is approximately 1.8 miles (3km) from the scene.

Forensic Findings

Semen has been found on the body of the girl (mostly within the vaginal cavity), along with traces of saliva. Ligature marks on her neck indicate strangulation (the offender appears to have used her underwear). Several footprints have been found leading to and from the road side. Blunt force trauma to the back of her head is observed as well as bruising to the neck.

Victimology

The victim is an 11 yr old student at the local primary school, currently enrolled in year 5. She has been described by her teacher as a ‘bright’ student. In terms of her physical appearance, she is a slight build (perhaps small for her age), she is approximately 130cms in height, and she has light brown hair, green eyes. Her parents are recently divorced, she lives with her mother; her father lives two suburbs away and has visiting access for two days every fortnight. Her and her mother live in a low to middle class socio economic neighbourhood. Her mother describes her as a ‘shy’ girl. The victim owned two dogs. She attended choir practise every Monday and Tuesday.
Scenario 2

Crime Act/Event Summary
A 15 year-old girl has been abducted while riding her bike around her neighbourhood. Her parents have received several phone calls from an anonymous caller on the night of her abduction informing them that their daughter has been taken and they will soon see “just how strong he is”. The caller mentions details such as the victim’s school, her daily routine, and the street which he abducted her from. The caller used an electronic device to disguise his voice.

The offender called the victim’s parents again 3 days later, expressing remorse and ensuring that their daughter would be released.

The victim was found the 2 days later in a river 16 kms from her home. Her body has been wrapped in plastic garbage bags. It appears the bags were originally weighed using bricks and chains.

Another victim has been reported missing; an 11 year old girl who was abducted from her front yard. The offender has also contacted the victim’s mother and sister informing them both of the method in which their daughter/sister will be killed.

Forensic Findings

The victim’s body has ligature marks around her wrists, and dislocations of the wrist. She also has bruising around her ankles. Her cheeks and lips are bruised and chaffed. Her chest area also shows deep bruising. Her parents believe that her hair has been cut. She had been sexually assaulted and bite marks can be observed on the girl’s upper thigh region.

No weapon has been found at the scene where she was abducted, nor the site where she was found. Tyre marks have been found at a nearby boat ramp.

An autopsy has revealed that she would have been deceased within approximately 2-3 days after her abduction, even though the anonymous caller assured her parents that she was alive.

Victimology

The victim attends the local high school and is currently in year 9. She often rides her bike every Wednesday and Friday afternoon. She has previously been suspended from school for marijuana use. Her father has said that she can be quite “impulsive and opinionated”. She has a boyfriend that she has been seeing for approximately 3 months. He is in year 11 and attends the same high school. The victim and her family live in a middle class suburb. The victim enjoyed alternative music and often attended music festivals. Besides a difference in age, both victims are very similar in appearance – both having blonde hair and green eyes.
Scenario 3

Criminal Act/ Event Summary

A 7 year-old girl has been found deceased in a storm water pipe within an industrial area. The body was found by three young boys riding their bikes through the pipes. The girl’s hands and feet have been tied together using plastic snap-lock clips. She has a plastic bag over her head.

Forensic findings

Forensics indicate that she has been sexually assaulted; however, there are no traces of semen present. Traces of hair were found on her person, which have been identified as belonging to a canine, most probably a Labrador. Ligature marks to her neck indicate the use of a garrotte device.

Victimology

Last seen two days ago in a park near residence, 38.2 miles (62 kms) from disposal site. When questioned, the victim’s parents state that they do not own a dog.

The victim often played in her backyard cubby house and this is the likely location from which she was abducted. The girl’s parents also state that she has recently started a ‘pen pal’ program.

There have been three other girls abducted and murdered in a similar manner in the past 8 weeks. All of them between the ages of 5 and 8. Each was presumed to be taken from their backyard.

All four girls enjoyed sports and are registered in athletics classes on Monday and Friday nights. All four girls attend the same school. Two of the four girls had had dental appointments in the last 4 weeks.

Miscellaneous

Witnesses have reported seeing a black Ford Fairlane, in very good condition, circling the area occasionally.
Scenario 4

Criminal Act/ Crime scene

A 47 year old woman has been found deceased in her unit. She has been stabbed approximately 32 times in the face, chest and neck regions. A relative has claimed that jewellery has been taken from her person. However, nothing else appears to be taken from the scene. There is minimal blood around the body.

Forensic Findings

Forensic analysis of the rest of the property has revealed a large amount of blood traces in the bathroom; specifically the shower recess, which it appears the perpetrator, has attempted to clean.

Victimology

The victim is recently separated from her spouse. She works as a nurse and has lived in the unit for 4 months. She enjoys horse riding. She has two close friends, one male, one female –these friends are in a relationship with each other.
Appendix B

Real-Time Critical Decision Method Protocol

2007/2008

School of Psychology and MARCS
Human Factors and Performance Research Group

University of Western Sydney
Instructions for participant:

You will be provided with several (4) brief scenarios describing criminal acts. These scenarios are designed to stimulate discussion. After reading each scenario you will be asked several questions. It is important that you are aware that there are no right or wrong answers to the questions asked – your performance is not being assessed. Try to say whatever you are thinking – the point of the interview is to understand your ‘thinking’ process, don’t be afraid to talk ideas through aloud.
Interview Protocol

Crime-related information

- What were your immediate thoughts upon reading the scenario?

- What things in the vignette are immediately of interest to you in terms of an investigation? (Think-aloud) Why did you target these features?

- Do you often target these features in other cases? E.g., do you always look for X?

- Can you please detail the relevance of these features to the investigation, and the concepts which come to mind when attending to these features? (Think-aloud)

- What other important aspects would you consider that weren’t described in the scenario that may have occurred in this crime (e.g., in similar cases what other indicators have you found)?

- If I was a trainee/ if you were working ‘off-site’, what information would you ask me to gather (If I were your eyes, what would you be seeing)? Why these aspects?

- In similar cases you have experienced, what other aspects have you noted that have turned out to be important in the suspect identification process?

- If you were asked to construct a profile of the perpetrator of this crime, what other things would you need to know about the crime, and what characteristics could you derive from this information?

- What were the most important piece(s) of information that you used to construct a profile?

- Does this description remind you of any cases that you have investigated previously?
Offender-related information

- Given the current scenario, can you please tell me what things you would include in a profile of the unknown offender?

- What indicators would you look for in an offender when investigating this type of crime? Why would you look at these features in particular?

- What does each of the features you have identified tell you about the offender? (List each feature one by one and wait for response) How do you make these associations?

- Are any of these features more important in terms of identifying the offender? (e.g., are some more salient/observable?). Are some more useful in apprehension?

- Are these offender-related features relevant in the investigation of other violent crimes?

- How often do you use each of these (offender-related) features? Are any more commonly used than others in the analysis of violent crimes?

- Were you, at any time, reminded of previous experiences in which a similar profile was made?

- Were any of the features that you identified specific to the case in question?

- Overall, what offender-related features do you most often target when creating a profile?
Appendix C

The P-CAT Script for Use in DMDX: Study 2a
## Appendix D

The P-CAT Familiarisation Trials

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<th>Prime Stimulus</th>
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<td>Sky</td>
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<td>Ocean</td>
<td>Wharf</td>
</tr>
</tbody>
</table>
Appendix E

Preliminary investigations to determine concept label presentation durations within the P-CAT

It has been established that stimuli length does not significantly impact response latencies in lexical decision tasks, for normal reading adults (Juphard et al., 2004). This is most likely due to the global nature of word processing (Ans, Carbonnel, & Valdois, 1998). As such, it was presumed that stimuli length would have a minimal effect on response latency within the P-CAT, provided that a suitable presentation duration, which allowed participants to accurately read each label, could be derived. Consequently, it was important to determine suitable durations for concept labels presented in the P-CAT. A preliminary investigation was performed to determine these presentation times.

Method

Participants

Three participants were asked to provide feedback in regard their ability to accurately read a number of concept labels.

Stimuli

The concept labels identified in Study 1 were presented to participants using a presentation format consistent with the P-CAT. The labels were presented to participants on a laptop computer (LG, 17” colour monitor, ATi Mobility X1400, 1GB DDR2 667
MHz RAM) using DMDX software (Forster & Forster, 2003). The same laptop was used for all participants to maintain a consistent screen refresh rate of 16.46ms.

Procedure

The participants were seated in front of the laptop computer. They were instructed that they would be presented with 69 concept labels. Each presentation would be shown for a duration of 1646ms (100 ticks (units of refresh rate) in DMDX program). This duration was chosen as it constitutes a fairly rapid presentation of the concept labels which would theoretically promote recognition memory, rather than a process of deduction. For each presentation, participants were asked, where possible, to read the concept labels aloud.

Results/Conclusion

The experimenter recorded participants’ ability to read the concept labels aloud. They were scored either correct or incorrect for each presentation. The results revealed that all participants were able to accurately read the concept labels which were presented for durations of 1646ms (10 ticks). Consequently, a time of 1646ms was deemed suitable for presentation durations of the 69 concept labels presented as targets in the P-CAT.

To promote the recognition of the target, it was deemed reasonable to increase the presentation duration of concept labels used as the initial prime in the P-CAT (i.e., the initial presentation of the crime-related concept label at centre of screen). This increase in duration was designed to promote the activation/retrieval of a range of potentially related concepts. Consequently, concept labels presented as the initial prime will be presented for a duration of 3292 ms; twice the duration of the target word.
References


# Appendix F

## Expert and Novice Target Samples

<table>
<thead>
<tr>
<th>Target Sample</th>
<th>Expert</th>
<th>Novice</th>
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<tbody>
<tr>
<td>Crime-Concept</td>
<td>Offender-Concept</td>
<td>Crime-Concept</td>
</tr>
<tr>
<td>Destruction of Evidence</td>
<td>Criminal</td>
<td>Level of</td>
</tr>
<tr>
<td>Criminal Sophistication</td>
<td>Organisation</td>
<td>Intelligence</td>
</tr>
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<td>Method of Body Concealment</td>
<td>Degree of Intelligence</td>
<td>Destruction of Evidence</td>
</tr>
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<td>Method of Approach</td>
<td>Social Competency</td>
<td>Victim Similarity</td>
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<td>Injury Type/Location</td>
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<td>Victim Selection</td>
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<tr>
<td>Staging</td>
<td>Degree of Intelligence</td>
<td>Level of Organisation</td>
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<td>Point/Method of Entry</td>
<td>Degree of Intelligence</td>
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<td>Degree of Force Used</td>
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<td>Degree of Force</td>
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<td>Criminal Sophistication</td>
<td>Rituals/Signatures</td>
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### Expert and Novice Target Samples continued

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<td><strong>Crime-Concept</strong></td>
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<td><strong>Evidence of Fantasy</strong></td>
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**Variables**

- Degree of Intelligence
- Depersonalisation
- Sexual Competency
- Intimate Knowledge of Victim
- Relationship with Victim
- Social Competency
- Degree of Intelligence
- Addictive Behaviours
- Anti-Social Behaviours
- Victim Maintained Social Competency
- Location of Residence/Work
- Method of Approach
- Method of Body Concealment
- Relationship with Victim
- Social Competency
- Criminal Sophistication
- Sophistication
- Victim Similarity
### Expert and Novice Target Samples continued

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Appendix G

Association Perception Survey Information

ETHICS APPROVAL NUMBER: HREC07-199

PARTICIPANT INFORMATION

THIS PROJECT IS BEING CONDUCTED IN CONJUNCTION WITH ASS PROF. MARK WIGGINS, FROM THE UNIVERSITY, OF WESTERN SYDNEY, BANKSTOWN

MARCS Auditory Laboratories, University of Western Sydney, invites you to participate in a research study examining the nature of expertise in the domain of criminal investigative analysis. The project aims to understand potential differences in information use by ‘novice’ and ‘expert’ criminal investigators. This will eventually lead to the development of a training and development initiative for ‘novice’ criminal investigators.

As part of this study, you will be asked to complete an online questionnaire. Within the questionnaire, you will be presented with 20 Feature-Event Pairings. Pairings detail a number of cue components made up from aspects of a crime (e.g., details of the act, forensic findings, Victimology, etc.) and characteristics of the perpetrator (e.g., Intelligence, Post-Event Behaviour, Pre-Event Stressors, etc.). Several potential associations between these two concepts have been identified previously by investigators’ of differing expertise level ranging from novice to highly experienced, and from different training and philosophical backgrounds. The usefulness of such associations in memory ultimately depends on the context (the relative values for each concept) of the case and the presence or absence of other information.

For each pairing, you will be asked to rate on several scales, your perceptions in regard to the strength of the potential association between the two concepts, and the specificity of the potential association to the domain (field) of profiling. All data will be treated in strictest confidence, and only used for scientific purposes. The results will be averaged across all participants and will remain anonymous. No names will be recorded.

IMPORTANT: It should be noted that the cue components detailed do not represent causal relationships between the two concepts (crime-offender) but, merely, a level of relatedness or association between the concepts - They are not rules. Using these associations as rules may lead to oversimplification of complex decision tasks and serious error.

You have a right not to participate in, or subsequently withdraw from the study. If you make the decision not to participate, you can withdraw without loss of reimbursement. If you feel discomfort as a result of participating, please contact Lifeline on 13 11 14 or at http://www.lifeline.org.au. If you agree to take part in this study, you will be asked to sign a consent form.
If you would like additional information on the project or have any questions please do not hesitate to contact myself, Ben Morrison, or my primary supervisor Dr. Mark Wiggins.

Yours sincerely,

Ben Morrison

MARCS Auditory Laboratories

University of Western Sydney, Bankstown Campus

Ph: (02) 9772 6660

Fax: (02) 9772 6326

b.morrison@uws.edu.au

Ben Morrison
Please rate each association on the scales provided.

**ASSOCIATION ONE** The potential association between:

*Destruction of Evidence* and the Offender's *Criminal Sophistication*

1. How often do you use this association?

Please Circle One Option

<table>
<thead>
<tr>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
</table>

2. How strong is this association compared to other ones that you may encounter?

<table>
<thead>
<tr>
<th>Extremely Weak</th>
<th>Weak</th>
<th>Somewhat Weak</th>
<th>Equidistant</th>
<th>Somewhat Strong</th>
<th>Strong</th>
<th>Extremely Strong</th>
</tr>
</thead>
</table>

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

<table>
<thead>
<tr>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
</table>

4. To what extent is the association distinct to the practice of profiling?

<table>
<thead>
<tr>
<th>Extremely Indistinct</th>
<th>Indistinct</th>
<th>Somewhat Indistinct</th>
<th>Equidistant</th>
<th>Somewhat Distinct</th>
<th>Distinct</th>
<th>Extremely Distinct</th>
</tr>
</thead>
</table>
Please rate each association on the scales provided.

**ASSOCIATION TWO** The potential association between:

*Method of Body Concealment* and the Offender's *Degree of Intelligence*

1. How often do you use this association?

Please Circle One Option

- Never
- Very Rarely
- Rarely
- Equidistant
- Sometimes
- Often
- Always

2. How strong is this association compared to other ones that you may encounter?

- Extremely Weak
- Weak
- Somewhat Weak
- Equidistant
- Somewhat Strong
- Strong
- Extremely Strong

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

- Never
- Very Rarely
- Rarely
- Equidistant
- Sometimes
- Often
- Always

4. To what extent is the association distinct to the practice of profiling?

- Extremely Indistinct
- Indistinct
- Somewhat Indistinct
- Equidistant
- Somewhat Distinct
- Distinct
- Extremely Distinct
Please rate each association on the scales provided.

**ASSOCIATION THREE** The potential association between:

*Method of Approach* and the Offender’s *Social Competency*

1. How often do you use this association?
   
   Please Circle One Option

   Never  Very Rarely  Rarely  Equidistant  Sometimes  Often  Always

2. How strong is this association compared to other ones that you may encounter?

   Extremely Weak  Weak  Somewhat Weak  Equidistant  Somewhat Strong  Strong  Extremely Strong

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

   Never  Very Rarely  Rarely  Equidistant  Sometimes  Often  Always

4. To what extent is the association distinct to the practice of profiling?

   Extremely Indistinct  Indistinct  Somewhat Indistinct  Equidistant  Somewhat Distinct  Distinct  Extremely Distinct
Please rate each association on the scales provided.

ASSOCIATION FOUR The potential association between:

Level of Organisation and the Offender’s Degree of Intelligence

1. How often do you use this association?

Please Circle One Option

Never  Very Rarely  Rarely  Equidistant  Sometimes  Often  Always

2. How strong is this association compared to other ones that you may encounter?

Extremely Weak  Weak  Somewhat Weak  Equidistant  Somewhat Strong  Strong  Extremely Strong

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

Never  Very Rarely  Rarely  Equidistant  Sometimes  Often  Always

4. To what extent is the association distinct to the practice of profiling?

Extremely Indistinct  Indistinct  Somewhat Indistinct  Equidistant  Somewhat Distinct  Distinct  Extremely Distinct
Please rate each association on the scales provided.

**ASSOCIATION FIVE** The potential association between:

_Destruction of Evidence_ and the Offender’s _Criminal History_

1. How often do you use this association?

Please Circle One Option

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<thead>
<tr>
<th></th>
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<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
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<th>Always</th>
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2. How strong is this association compared to other ones that you may encounter?

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3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

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<th></th>
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4. To what extent is the association distinct to the practice of profiling?

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<tr>
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<th>Equidistant</th>
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<th>Distinct</th>
<th>Extremely Distinct</th>
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</table>
Please rate each association on the scales provided.

**ASSOCIATION SIX** The potential association between:

*Victim Similarity* and the Offender’s *Relationship with Victim*

1. How often do you use this association?
   
   Please Circle One Option

<table>
<thead>
<tr>
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<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
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2. How strong is this association compared to other ones that you may encounter?

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<th>Equidistant</th>
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3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

<table>
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<th>Rarely</th>
<th>Equidistant</th>
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4. To what extent is the association distinct to the practice of profiling?

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<th>Somewhat Indistinct</th>
<th>Equidistant</th>
<th>Somewhat Distinct</th>
<th>Distinct</th>
<th>Extremely Distinct</th>
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</table>
Please rate each association on the scales provided.

**ASSOCIATION SEVEN** The potential association between:

*Injury Type/Location* and the Offender’s *Relationship with Victim*

1. How often do you use this association?
   Please Circle One Option

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<tr>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
<th>Sometimes</th>
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2. How strong is this association compared to other ones that you may encounter?

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3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

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<th>Rarely</th>
<th>Equidistant</th>
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<th>Equidistant</th>
<th>Somewhat Distinct</th>
<th>Distinct</th>
<th>Extremely Distinct</th>
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</table>
Please rate each association on the scales provided.

**ASSOCIATION EIGHT** The potential association between:

**Victim Selection** and the Offender’s **Criminal History**

1. How often do you use this association?

   Please Circle One Option

<table>
<thead>
<tr>
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<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
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2. How strong is this association compared to other ones that you may encounter?

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<th>Somewhat Weak</th>
<th>Equidistant</th>
<th>Somewhat Strong</th>
<th>Strong</th>
<th>Extremely Strong</th>
</tr>
</thead>
</table>

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

<table>
<thead>
<tr>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
</table>

4. To what extent is the association distinct to the practice of profiling?

<table>
<thead>
<tr>
<th>Extremely Indistinct</th>
<th>Indistinct</th>
<th>Somewhat Indistinct</th>
<th>Equidistant</th>
<th>Somewhat Distinct</th>
<th>Distinct</th>
<th>Extremely Distinct</th>
</tr>
</thead>
</table>
Please rate each association on the scales provided.

**ASSOCIATION NINE** The potential association between:

*Level of Organisation* and the Offender’s *Criminal Sophistication*

1. How often do you use this association?

Please Circle One Option

- Never
- Very Rarely
- Rarely
- Equidistant
- Sometimes
- Often
- Always

2. How strong is this association compared to other ones that you may encounter?

- Extremely Weak
- Weak
- Somewhat Weak
- Equidistant
- Somewhat Strong
- Strong
- Extremely Strong

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

- Never
- Very Rarely
- Rarely
- Equidistant
- Sometimes
- Often
- Always

4. To what extent is the association distinct to the practice of profiling?

- Extremely Indistinct
- Indistinct
- Somewhat Indistinct
- Equidistant
- Somewhat Distinct
- Distinct
- Extremely Distinct
Please rate each association on the scales provided.

**ASSOCIATION TEN** The potential association between:

*Staging* and the Offender’s *Degree of Intelligence*

1. How often do you use this association?

Please Circle One Option

Never  Very Rarely  Rarely  Equidistant  Sometimes  Often  Always

2. How strong is this association compared to other ones that you may encounter?

Extremely Weak  Weak  Somewhat Weak  Equidistant  Somewhat Strong  Strong  Extremely Strong

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

Never  Very Rarely  Rarely  Equidistant  Sometimes  Often  Always

4. To what extent is the association distinct to the practice of profiling?

Extremely Indistinct  Indistinct  Somewhat Indistinct  Equidistant  Somewhat Distinct  Distinct  Extremely Distinct
Please rate each association on the scales provided.

ASSOCIATION ELEVEN The potential association between:

Point/Method of Entry and the Offender’s Degree of Intelligence

1. How often do you use this association?

Please Circle One Option

Never  Very Rarely  Rarely  Equidistant  Sometimes  Often  Always

2. How strong is this association compared to other ones that you may encounter?

Extremely  Weak  Somewhat  Weak  Equidistant  Somewhat  Strong  Strong  Extremely

Weak  Weak  Strong

3. How often does the value/meaning of this association depend on the presence or
absence of other information within a case?

Never  Very Rarely  Rarely  Equidistant  Sometimes  Often  Always

4. To what extent is the association distinct to the practice of profiling?

Extremely  Indistinct  Somewhat  Indistinct  Equidistant  Somewhat  Distinct  Distinct  Extremely

Indistinct  Indistinct  Distinct  Distinct
Please rate each association on the scales provided.

ASSOCIATION TWELVE: The potential association between:

Victim Age and the Offender’s Offender Age

1. How often do you use this association?

Please Circle One Option

Never  Very Rarely  Rarely  Equidistant  Sometimes  Often  Always

2. How strong is this association compared to other ones that you may encounter?

Extremely Weak  Weak  Somewhat Weak  Equidistant  Somewhat Strong  Strong  Extremely Strong

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

Never  Very Rarely  Rarely  Equidistant  Sometimes  Often  Always

4. To what extent is the association distinct to the practice of profiling?

Extremely Indistinct  Indistinct  Somewhat Indistinct  Equidistant  Somewhat Distinct  Distinct  Extremely Distinct
Please rate each association on the scales provided.

**ASSOCIATION THIRTEEN** The potential association between:

*Degree of Force Used* and the Offender’s *Military History*

1. How often do you use this association?
Please Circle One Option

<table>
<thead>
<tr>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
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</table>

2. How strong is this association compared to other ones that you may encounter?

<table>
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<tr>
<th>Extremely Weak</th>
<th>Weak</th>
<th>Somewhat Weak</th>
<th>Equidistant</th>
<th>Somewhat Strong</th>
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<th>Extremely Strong</th>
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</table>

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

<table>
<thead>
<tr>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
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</table>

4. To what extent is the association distinct to the practice of profiling?

<table>
<thead>
<tr>
<th>Extremely Indistinct</th>
<th>Indistinct</th>
<th>Somewhat Indistinct</th>
<th>Equidistant</th>
<th>Somewhat Distinct</th>
<th>Distinct</th>
<th>Extremely Distinct</th>
</tr>
</thead>
</table>
Please rate each association on the scales provided.

**ASSOCIATION FOURTEEN** The potential association between:

*Degree of Force Used* and the Offender’s *Relationship with Victim*

1. How often do you use this association?

Please Circle One Option

<table>
<thead>
<tr>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
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</thead>
</table>

2. How strong is this association compared to other ones that you may encounter?

<table>
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<tr>
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<th>Weak</th>
<th>Somewhat Weak</th>
<th>Equidistant</th>
<th>Somewhat Strong</th>
<th>Strong</th>
<th>Extremely Strong</th>
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</thead>
</table>

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

<table>
<thead>
<tr>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
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4. To what extent is the association distinct to the practice of profiling?

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<th>Equidistant</th>
<th>Somewhat Distinct</th>
<th>Distinct</th>
<th>Extremely Distinct</th>
</tr>
</thead>
</table>
Please rate each association on the scales provided.

**ASSOCIATION FIFTEEN** The potential association between:

*Staging* and the *Offender's Criminal Sophistication*

1. How often do you use this association?

Please Circle One Option

<table>
<thead>
<tr>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
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2. How strong is this association compared to other ones that you may encounter?

<table>
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<tr>
<th>Extremely Weak</th>
<th>Weak</th>
<th>Somewhat Weak</th>
<th>Equidistant</th>
<th>Somewhat Strong</th>
<th>Strong</th>
<th>Extremely Strong</th>
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</table>

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

<table>
<thead>
<tr>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
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</table>

4. To what extent is the association distinct to the practice of profiling?

<table>
<thead>
<tr>
<th>Extremely Indistinct</th>
<th>Indistinct</th>
<th>Somewhat Indistinct</th>
<th>Equidistant</th>
<th>Somewhat Distinct</th>
<th>Distinct</th>
<th>Extremely Distinct</th>
</tr>
</thead>
</table>
Please rate each association on the scales provided.

**ASSOCIATION SIXTEEN** The potential association between:

**Rituals Signatures** and the Offender’s **Mental State/History**

1. How often do you use this association?

Please Circle One Option

- Never
- Very Rarely
- Rarely
- Equidistant
- Sometimes
- Often
- Always

2. How strong is this association compared to other ones that you may encounter?

- Extremely
- Weak
- Somewhat Weak
- Equidistant
- Somewhat Strong
- Strong
- Extremely Strong

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

- Never
- Very Rarely
- Rarely
- Equidistant
- Sometimes
- Often
- Always

4. To what extent is the association distinct to the practice of profiling?

- Extremely
- Indistinct
- Somewhat Indistinct
- Equidistant
- Somewhat Distinct
- Distinct
- Extremely Distinct
Please rate each association on the scales provided.

**ASSOCIATION SEVENTEEN** The potential association between:

Victim Maintained and the Offender's Criminal Sophistication

1. How often do you use this association?

Please Circle One Option

- Never
- Very Rarely
- Rarely
- Equidistant
- Sometimes
- Often
- Always

2. How strong is this association compared to other ones that you may encounter?

- Extremely Weak
- Weak
- Somewhat Weak
- Equidistant
- Somewhat Strong
- Strong
- Extremely Strong

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

- Never
- Very Rarely
- Rarely
- Equidistant
- Sometimes
- Often
- Always

4. To what extent is the association distinct to the practice of profiling?

- Extremely Indistinct
- Indistinct
- Somewhat Indistinct
- Equidistant
- Somewhat Distinct
- Distinct
- Extremely Distinct
Please rate each association on the scales provided.

**ASSOCIATION EIGHTEEN** The potential association between:

*Point/Method of Entry* and the Offender's **Criminal Sophistication**

1. How often do you use this association?
   Please Circle One Option

   Never  Very Rarely  Rarely  Equidistant  Sometimes  Often  Always

2. How strong is this association compared to other ones that you may encounter?

   Extremely Weak  Weak  Somewhat Weak  Equidistant  Somewhat Strong  Strong  Extremely Strong

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

   Never  Very Rarely  Rarely  Equidistant  Sometimes  Often  Always

4. To what extent is the association distinct to the practice of profiling?

   Extremely Indistinct  Indistinct  Somewhat Indistinct  Equidistant  Somewhat Distinct  Distinct  Extremely Distinct
Please rate each association on the scales provided.

ASSOCIATION NINETEEN The potential association between:

*Degree of Force Used* and the Offender’s *Post-Event Behaviour*

1. How often do you use this association?

<table>
<thead>
<tr>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
</table>

2. How strong is this association compared to other ones that you may encounter?

<table>
<thead>
<tr>
<th>Extremely Weak</th>
<th>Weak</th>
<th>Somewhat Weak</th>
<th>Equidistant</th>
<th>Somewhat Strong</th>
<th>Strong</th>
<th>Extremely Strong</th>
</tr>
</thead>
</table>

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

<table>
<thead>
<tr>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Equidistant</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
</table>

4. To what extent is the association distinct to the practice of profiling?

<table>
<thead>
<tr>
<th>Extremely Indistinct</th>
<th>Indistinct</th>
<th>Somewhat Indistinct</th>
<th>Equidistant</th>
<th>Somewhat Distinct</th>
<th>Distinct</th>
<th>Extremely Distinct</th>
</tr>
</thead>
</table>
Please rate each association on the scales provided.

**ASSOCIATION TWENTY** The potential association between:

**Victim Similarity** and the Offender’s **Offender Age**

1. How often do you use this association?

Please Circle One Option

[Scale: Never, Very Rarely, Rarely, Equidistant, Sometimes, Often, Always]

2. How strong is this association compared to other ones that you may encounter?

[Scale: Extremely Weak, Somewhat Weak, Equidistant, Somewhat Strong, Strong, Extremely Strong]

3. How often does the value/meaning of this association depend on the presence or absence of other information within a case?

[Scale: Never, Very Rarely, Rarely, Equidistant, Sometimes, Often, Always]

4. To what extent is the association distinct to the practice of profiling?

[Scale: Extremely Indistinct, Somewhat Indistinct, Equidistant, Somewhat Distinct, Distinct, Extremely Distinct]
## Appendix H

**The Expert Target Sample (46 Concept Pairings)**

<table>
<thead>
<tr>
<th>Crime-Concept</th>
<th>Offender-Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destruction of Evidence</td>
<td>Criminal Sophistication</td>
</tr>
<tr>
<td>Method of Body Concealment</td>
<td>Degree of Intelligence</td>
</tr>
<tr>
<td>Method of Approach</td>
<td>Social Competency</td>
</tr>
<tr>
<td>Injury Type/Location</td>
<td>Relationship with Victim</td>
</tr>
<tr>
<td>Staging</td>
<td>Degree of Intelligence</td>
</tr>
<tr>
<td>Point/Method of Entry</td>
<td>Degree of Intelligence</td>
</tr>
<tr>
<td>Degree of Force Used</td>
<td>Relationship with Victim</td>
</tr>
<tr>
<td>Staging</td>
<td>Criminal Sophistication</td>
</tr>
<tr>
<td>Point/Method of Entry</td>
<td>Criminal Sophistication</td>
</tr>
<tr>
<td>Degree of Force Used</td>
<td>Post-Event Behaviour</td>
</tr>
<tr>
<td>Intimate Knowledge of Victim</td>
<td>Relationship with Victim</td>
</tr>
<tr>
<td>Victim Selection</td>
<td>Pre-Event Stressors</td>
</tr>
<tr>
<td>Window of Opportunity</td>
<td>Pre-Event Stressors</td>
</tr>
<tr>
<td>Depersonalisation of Victim</td>
<td>Relationship with Victim</td>
</tr>
<tr>
<td>Victim Maintained</td>
<td>Possession of Secure Site</td>
</tr>
<tr>
<td>Staging</td>
<td>Relationship with Victim</td>
</tr>
<tr>
<td>Method of Body Concealment</td>
<td>Familiarity with Location</td>
</tr>
<tr>
<td>Evidence of Fantasy</td>
<td>Degree of Intelligence</td>
</tr>
<tr>
<td>Crime-Concept</td>
<td>Offender-Concept</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>UNSUB Contact</td>
<td>Addictive Behaviours</td>
</tr>
<tr>
<td>Positioning of Victim</td>
<td>Relationship with Victim</td>
</tr>
<tr>
<td>Torture/Sadistic Behaviours</td>
<td>Post-Event Behaviours</td>
</tr>
<tr>
<td>Victim Selection</td>
<td>Degree of Intelligence</td>
</tr>
<tr>
<td>Method of Body Concealment</td>
<td>Criminal Sophistication</td>
</tr>
<tr>
<td>Torture/Sadistic Behaviours</td>
<td>Pre-Event Stressors</td>
</tr>
<tr>
<td>Point/Method of Entry</td>
<td>Familiarity with Location</td>
</tr>
<tr>
<td>Rituals/Signatures</td>
<td>Addictive Behaviours</td>
</tr>
<tr>
<td>Deception/Manipulation</td>
<td>Social Competency</td>
</tr>
<tr>
<td>Evidence of Fantasy</td>
<td>Post-Event Behaviours</td>
</tr>
<tr>
<td>Evidence of Fantasy</td>
<td>Relationship with Victim</td>
</tr>
<tr>
<td>Victim Risk Level</td>
<td>Pre-Event Stressors</td>
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<tr>
<td>Deception/Manipulation</td>
<td>Degree of Intelligence</td>
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<tr>
<td>Point/Method of Entry</td>
<td>Relationship with Victim</td>
</tr>
<tr>
<td>Transportation of Victim</td>
<td>Criminal Sophistication</td>
</tr>
<tr>
<td>Level of Organisation</td>
<td>Degree of Intelligence</td>
</tr>
<tr>
<td>Torture/Sadistic Behaviours</td>
<td>Personality Variables</td>
</tr>
<tr>
<td>Level of Organisation</td>
<td>Criminal Sophistication</td>
</tr>
<tr>
<td>Method of Approach</td>
<td>Relationship with Victim</td>
</tr>
<tr>
<td>Expert Target Sample (46 Concept Pairings)</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
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<td><strong>Crime-Concept</strong></td>
<td><strong>Offender-Concept</strong></td>
</tr>
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<td>Point/Method of Entry</td>
<td>Social Competency</td>
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<td>Restraints/Bondage</td>
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<td>Window of Opportunity</td>
<td>Location of Residence/Work</td>
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<td>Torture/Sadistic Behaviours</td>
<td>Addictive Behaviours</td>
</tr>
<tr>
<td>Method of Approach</td>
<td>Familiarity with Victim</td>
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<tr>
<td>Victim Mental State</td>
<td>Degree of Intelligence</td>
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<tr>
<td>Evidence of Fantasy</td>
<td>Personality Variables</td>
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<tr>
<td>Transportation of Victim</td>
<td>Familiarity with Location</td>
</tr>
<tr>
<td>Method of Body Concealment</td>
<td>Relationship with Victim</td>
</tr>
</tbody>
</table>
Appendix I

The Revised P-CAT Script for Use in DMDX: Study 3a
Appendix J

The ACE Training Program Script for Use in DMDX: Study 3a
Appendix K

Pen & Paper Paired-Concept Recognition Test

2007/2008

School of Psychology and MARCS
Human Factors and Performance Research Group

University of Western Sydney
**Level 1**

For the following crime-concept (listed below on left), please indicate the offender concept/s that may be associated (listed below on right)

<table>
<thead>
<tr>
<th>Method of Body Concealment</th>
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</thead>
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<td>Degree of Intelligence</td>
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<tr>
<td></td>
<td>Criminal Sophistication</td>
</tr>
<tr>
<td></td>
<td>Pre-Event Stressors</td>
</tr>
<tr>
<td></td>
<td>Familiarity with Location</td>
</tr>
<tr>
<td></td>
<td>Post-Event Behaviour</td>
</tr>
<tr>
<td></td>
<td>Social Competency</td>
</tr>
<tr>
<td></td>
<td>Personality Variables</td>
</tr>
<tr>
<td></td>
<td>Location of Residence/Work</td>
</tr>
<tr>
<td></td>
<td>Possession of Secure Site</td>
</tr>
<tr>
<td></td>
<td>Addictive Behaviors</td>
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</table>

<table>
<thead>
<tr>
<th>Destruction of Evidence</th>
<th>Relationship with Victim</th>
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</thead>
<tbody>
<tr>
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<tr>
<td></td>
<td>Criminal Sophistication</td>
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<tr>
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<td>Pre-Event Stressors</td>
</tr>
<tr>
<td></td>
<td>Familiarity with Location</td>
</tr>
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<td></td>
<td>Post-Event Behaviour</td>
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<tr>
<td></td>
<td>Social Competency</td>
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<td>Personality Variables</td>
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<td></td>
<td>Location of Residence/Work</td>
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<td>Possession of Secure Site</td>
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<td>Addictive Behaviors</td>
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<table>
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<td>Relationship with Victim</td>
</tr>
<tr>
<td>Degree of Intelligence</td>
<td>Degree of Intelligence</td>
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<tr>
<td>Criminal Sophistication</td>
<td>Criminal Sophistication</td>
</tr>
<tr>
<td>Pre-Event Stressors</td>
<td>Pre-Event Stressors</td>
</tr>
<tr>
<td>Familiarity with Location</td>
<td>Familiarity with Location</td>
</tr>
<tr>
<td>Post-Event Behaviour</td>
<td>Post-Event Behaviour</td>
</tr>
<tr>
<td>Social Competency</td>
<td>Social Competency</td>
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<tr>
<td>Personality Variables</td>
<td>Personality Variables</td>
</tr>
<tr>
<td>Location of Residence/Work</td>
<td>Location of Residence/Work</td>
</tr>
<tr>
<td>Possession of Secure Site</td>
<td>Possession of Secure Site</td>
</tr>
<tr>
<td>Addictive Behaviors</td>
<td>Addictive Behaviors</td>
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</tbody>
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**Level 1 Score ___________**
**Level 2**

For the following crime-concept (listed below on left), please indicate the offender concept/s that may be associated (listed below on right)

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<thead>
<tr>
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<th>Relationship with Victim</th>
<th>Degree of Intelligence</th>
<th>Criminal Sophistication</th>
<th>Pre-Event Stressors</th>
<th>Familiarity with Location</th>
<th>Post-Event Behaviour</th>
<th>Social Competency</th>
<th>Personality Variables</th>
<th>Location of Residence/Work</th>
<th>Possession of Secure Site</th>
<th>Addictive Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury Type/Location</td>
<td>Relationship with Victim</td>
<td>Degree of Intelligence</td>
<td>Criminal Sophistication</td>
<td>Pre-Event Stressors</td>
<td>Familiarity with Location</td>
<td>Post-Event Behaviour</td>
<td>Social Competency</td>
<td>Personality Variables</td>
<td>Location of Residence/Work</td>
<td>Possession of Secure Site</td>
<td>Addictive Behaviors</td>
</tr>
<tr>
<td>Staging</td>
<td>Relationship with Victim</td>
<td>□</td>
<td></td>
<td></td>
<td></td>
<td></td>
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Level 2 Score __________
**Level 3**

For the following crime-concept (listed below on left), please indicate the offender concept/s that may be associated (listed below on right)

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**Level 3 Score ___________**
**Level 4**

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| | <strong>Familiarity with Location</strong> | ☐ |
| | <strong>Post-Event Behaviour</strong> | ☐ |
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| | <strong>Personality Variables</strong> | ☐ |
| | <strong>Location of Residence/Work</strong> | ☐ |
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| | <strong>Addictive Behaviours</strong> | ☐ |</p>
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<tr>
<td>Pre-Event Stressors</td>
<td></td>
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<tr>
<td>Familiarity with Location</td>
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<tr>
<td>Post-Event Behaviour</td>
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<tr>
<td>Social Competency</td>
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<tr>
<td>Personality Variables</td>
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<tr>
<td>Location of Residence/Work</td>
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<tr>
<td>Possession of Secure Site</td>
<td></td>
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</tr>
<tr>
<td>Addictive Behaviours</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th><strong>Victim Mental State</strong></th>
<th>✓</th>
<th>✓</th>
<th>✓</th>
<th>✓</th>
<th>✓</th>
<th>✓</th>
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<tbody>
<tr>
<td>Relationship with Victim</td>
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<td>Criminal Sophistication</td>
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<td>Pre-Event Stressors</td>
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<tr>
<td>Familiarity with Location</td>
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<td>Post-Event Behaviour</td>
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<tr>
<td>Social Competency</td>
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<tr>
<td>Personality Variables</td>
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<tr>
<td>Location of Residence/Work</td>
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</tr>
<tr>
<td>Possession of Secure Site</td>
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<tr>
<td>Addictive Behaviours</td>
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</tr>
</tbody>
</table>

**Level 4 Score** ____________
Appendix L

A Complete Animated Demonstration of both an Implicit Scenario and an Explicit Scenario
Scenario 1 (Graphic):

Scenario 1 (Implicit):
A 12-year old, Caucasian girl has been raped and murdered in the small town where she lived. She was abducted from the driveway of her parents’ house, after taking the school bus home, at approximately 3.30pm. Her body was found four days later in bushlands approximately 16kms (10 miles) away from the abduction site. She was found face down, fully dressed; however, one of her shoes was unfastened and her head partially covered by her coat. The victim was found in secluded bushlands; however, there was little to no effort to conceal her body. This is the second sexual assault of a young girl in the area in the past seven months, the previous being of similar age and appearance. Nothing appears to have been taken from the scene. The victim has bruises to her arms, torso, and mouth regions. The victim was sexually assaulted, battered, and strangled. The cause of death was extreme trauma to the head which was the result of several blows to the head with a rock. The murder weapon, a rock, was found near the victim’s head, with blood on its surface. The victim was described by her parents as shy, timid, average to low self-esteem, cooperative, of average intelligence, mentally stable, comes from an average socioeconomic background, and has no developmental irregularities.
Scenario 1 (Explicit):

A 12-year old girl has been raped and murdered in the small town where she lived. She was abducted from the driveway of her parent’s house, after taking the school bus home. Her body was found four days later in bushlands approximately 16kms (10 miles) away from the abduction site. The events of interest are as follows:

<table>
<thead>
<tr>
<th>Crime Classification</th>
<th>Sexual Homicide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence of Fantasy</td>
<td>Not discernible</td>
</tr>
<tr>
<td>Transportation of Victim</td>
<td>Yes. The victim was transported from the driveway of her house to bushlands, a distance of approximately 16kms (10 miles). The amount of blood at the disposal scene suggests that she was killed there.</td>
</tr>
<tr>
<td>Serial Acts</td>
<td>Possible. A thirteen year old girl was raped in the same area, 7 months prior.</td>
</tr>
<tr>
<td>Removal of Items from scene/victim</td>
<td>No.</td>
</tr>
<tr>
<td>Verbal Behaviours</td>
<td>Unknown.</td>
</tr>
<tr>
<td>Positioning of victim body</td>
<td>Face down, fully dressed. However, her clothes showed signs of being put on in a hurry. For example, one of her shoes was unfastened, and her head was covered by her coat.</td>
</tr>
<tr>
<td>Staging</td>
<td>No evidence.</td>
</tr>
<tr>
<td>Escalation</td>
<td>If connected to the previous rape, the UNSUB has now escalated to murder.</td>
</tr>
<tr>
<td>Depersonalisation of victim</td>
<td>Possible. The victim was found face down, appears to have been raped from behind, and her head was partially covered by her coat.</td>
</tr>
<tr>
<td>Personalisation of victim</td>
<td>No evidence.</td>
</tr>
<tr>
<td>Method of Body Concealment</td>
<td>The victim was found in secluded bushlands; however, there was little to no effort to conceal her body.</td>
</tr>
<tr>
<td>Ritualistic/Signature Behaviours</td>
<td>No evidence.</td>
</tr>
<tr>
<td>Use of Restraints/Bondage</td>
<td>No.</td>
</tr>
<tr>
<td>Point/Method of Entry</td>
<td>n/a</td>
</tr>
<tr>
<td>Concealment/Destruction of evidence</td>
<td>No (e.g., weapon found at scene).</td>
</tr>
<tr>
<td>Level of Organisation</td>
<td>Very low (Disorganised).</td>
</tr>
<tr>
<td>Degree of Force used</td>
<td>Very violent, but not excessive (e.g., no overkill).</td>
</tr>
<tr>
<td>Method of Approach</td>
<td>A blitz approach is likely.</td>
</tr>
<tr>
<td>Victim Selection</td>
<td>Appears to be opportunistic in nature.</td>
</tr>
<tr>
<td>Time of Sexual/Violent Acts</td>
<td>The victim was raped prior to her death.</td>
</tr>
<tr>
<td>Torture/Sadistic Behaviours</td>
<td>No.</td>
</tr>
<tr>
<td>Injury Type/Locations</td>
<td>The victim was sexually assaulted, battered, strangled. The cause of death was extreme trauma to the head which was the result of several blows to the head with a rock.</td>
</tr>
<tr>
<td>Victim Age</td>
<td>12 years old.</td>
</tr>
<tr>
<td>Victim Race</td>
<td>Caucasian.</td>
</tr>
<tr>
<td>Victim Routine</td>
<td>The victim catches bus to and from school, Monday to Friday.</td>
</tr>
<tr>
<td>Victim Risk Level</td>
<td>Fairly high. The crime occurred during daylight.</td>
</tr>
<tr>
<td>Victim Resistance</td>
<td>Bruising suggests that she was abducted forcefully.</td>
</tr>
<tr>
<td>Victim Impulsivity</td>
<td>Low.</td>
</tr>
<tr>
<td>Victim Self-esteem</td>
<td>Low to average.</td>
</tr>
<tr>
<td>Victim Mental Health</td>
<td>Stable.</td>
</tr>
</tbody>
</table>
Victim Socioeconomic status – Average.
Victim Personality Variables – The victim was described as a shy, timid, and cooperative.
Victim Intelligence – Average.
Victim Developmental History – No irregularities.
UNSUB Intimate Knowledge of victim – Not discernible.
UNSUB Contact with Relations/Authorities/Media – No.
UNSUB Deception/Manipulation. Unlikely. Victim injuries are consistent with the use of force during abduction.
Victim Similarity with Previous Victims – Yes. Previous victim was of a similar age and appearance.
Window of Opportunity - Opportunistic nature suggests that the window of opportunity was relatively limited.
Victim Maintained for Length of Time - No. The time which lapsed between abduction and the victim’s death was relatively brief.

Scenario 1 (Persons of Interest):

Person of Interest (A)

Gender - Male
Age - 28
Build/Body Type – Average build, 6ft
Race - Caucasian
Criminal History – Minor assault charges
Criminal Sophistication – low
Mental State/History – No irregularities
Familiarity with location – Local to the area
Relationship with Victim – None
Pre-event Stressors – Not discernible
Relationship Status/Living situation – Living with ex-wife
Employment Type/History – Tree trimmer
Socioeconomic Status - Average
Routine/Lifestyle – Works early morning to afternoon hours
Post-Event Behaviours – No irregularities
Location of Residence/Work – Local to crimes
Personality Variables – Very confident, perceived as arrogant
Degree of Intelligence – Below average
Social Competency - Average
Anti-Social Behaviours – Not discernible
Military History – Yes. Dishonourable discharge
Sexual Competency – Undisclosed
Vehicle Type – Truck
Developmental History – No irregularities
Interests/Affiliations – Sports
Belief System/World View – Undisclosed
**Addictive Behaviours** – Smokes cigarettes
**Possession of Secure Site** – Yes (rented house with ex-wife)

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**Person of Interest (B)**

- **Gender** - Male
- **Age** - 19
- **Build/Body Type** – Average build, 6ft 1 inch
- **Race** - African
- **Criminal History** – Minor theft charges
- **Criminal Sophistication** – low
- **Mental State/History** – ADHD
- **Familiarity with location** – From neighbouring town
- **Relationship with Victim** – None
- **Pre-event Stressors** – Not discernible
- **Relationship Status/Living situation** – Lives with parents
- **Employment Type/History** – Unemployed
- **Socioeconomic Status** – Below average
- **Routine/Lifestyle** – No routine
- **Post-Event Behaviours** – No irregularities.
- **Location of Residence/Work** – Local to area
- **Personality Variables** – Extraverted
- **Degree of Intelligence** – Average
- **Social Competency** - Average
- **Anti-Social Behaviours** – Not discernible
- **Military History** – No
- **Sexual Competency** – Sexually active
- **Vehicle Type** – None
- **Developmental History** – No irregularities
- **Interests/Affiliations** – Music and Cars
- **Belief System/World View** – Undisclosed
- **Addictive Behaviours** – Undisclosed
- **Possession of Secure Site** – Yes (access to parents house)

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**Person of Interest (C)**

- **Gender** - Male
- **Age** - 30
- **Build/Body Type** - Average
- **Race** - Caucasian
- **Criminal History** – None
- **Criminal Sophistication** – Unknown
- **Mental State/History** – No irregularities
- **Familiarity with location** – From near town
- **Relationship with Victim** – Uncle
Pre-event Stressors – No
Relationship Status/Living situation – Married
Employment Type/History – Architect
Socioeconomic Status - Average
Routine/Lifestyle – Irregular hours
Post-Event Behaviours – No irregularities
Location of Residence/Work – Neighbouring town
Personality Variables – Introverted
Degree of Intelligence – Average to above average
Social Competency - Average
Anti-Social Behaviours – Nothing notable
Military History – No
Sexual Competency – Undisclosed
Vehicle Type – SUV
Developmental History – No irregularities
Interests/Affiliations – Sports
Belief System/World View – No details
Addictive Behaviours – No
Possession of Secure Site – Yes (he owns a house)
Scenario 2 (Graphic):

Empty Shell Casing

Scenario 2 (Implicit):

A 44 year old, Caucasian female has been found murdered on a park trail in a heavily wooded national park. Death was caused by a single gun shot to the side/back of the head; an empty shell casing has been found. The victim was found lying near a tree. The victim was not sexually assaulted. The victim has no defensive injuries. This is the second homicide in the areas in the past month; the previous having a similar MO, victim gender and race, four weeks earlier. Nothing appears to have been taken from the scene, nor does there appear to be signs of staging. The victim runs this trail regularly. The victim was described by friends as confident, independent, of high self esteem, average socioeconomic status, mentally stable, and of above average intelligence.
**Scenario 2 (Explicit):**

A 44 year old female has been found dead on a park trail in a heavily wooded national park. The Events of Interest are as follows:

<table>
<thead>
<tr>
<th>Event</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crime Classification</strong></td>
<td>Homicide</td>
</tr>
<tr>
<td><strong>Evidence of Fantasy</strong></td>
<td>Not discernible</td>
</tr>
<tr>
<td><strong>Transportation of Victim</strong></td>
<td>No. Kill site and disposal site are the same.</td>
</tr>
<tr>
<td><strong>Serial Acts</strong></td>
<td>Yes. One previous homicide with similar MO, victim gender and race, four weeks earlier.</td>
</tr>
<tr>
<td><strong>Removal of Items from scene/victim</strong></td>
<td>No</td>
</tr>
<tr>
<td><strong>Verbal Behaviours</strong></td>
<td>Unknown</td>
</tr>
<tr>
<td><strong>Positioning of victim body</strong></td>
<td>Lying near a tree</td>
</tr>
<tr>
<td><strong>Staging</strong></td>
<td>No evidence</td>
</tr>
<tr>
<td><strong>Escalation</strong></td>
<td>Not discernible</td>
</tr>
<tr>
<td><strong>Depersonalisation of victim</strong></td>
<td>No evidence</td>
</tr>
<tr>
<td><strong>Personalisation of victim</strong></td>
<td>No evidence</td>
</tr>
<tr>
<td><strong>Method of Body Concealment</strong></td>
<td>Although victims were all found in secluded areas, no explicit attempt was made to conceal their bodies.</td>
</tr>
<tr>
<td><strong>Ritualistic/Signature Behaviours</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>Use of Restraints/Bondage</strong></td>
<td>No</td>
</tr>
<tr>
<td><strong>Point/Method of Entry</strong></td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Concealment/Destruction of evidence</strong></td>
<td>No</td>
</tr>
<tr>
<td><strong>Level of Organisation</strong></td>
<td>Low. Although it would appear that the offender waited for his/her victim, there is little evidence of planning.</td>
</tr>
<tr>
<td><strong>Degree of Force used</strong></td>
<td>Violent, but not excessive</td>
</tr>
<tr>
<td><strong>Method of Approach</strong></td>
<td>The location of the gun shot wound and the lack of defensive injuries suggests that the victim was approached from behind (i.e., a blitz attack).</td>
</tr>
<tr>
<td><strong>Victim Selection</strong></td>
<td>Appears to be opportunistic in nature</td>
</tr>
<tr>
<td><strong>Time of Sexual/Violent Acts</strong></td>
<td>No sexual acts</td>
</tr>
<tr>
<td><strong>Torture/Sadistic Behaviours</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>Injury Type/Locations</strong></td>
<td>Single gun shot wound to the head</td>
</tr>
<tr>
<td><strong>Victim Age</strong></td>
<td>44 years old</td>
</tr>
<tr>
<td><strong>Victim Race</strong></td>
<td>Caucasian</td>
</tr>
<tr>
<td><strong>Victim Routine</strong></td>
<td>The victim does regularly walk/jog through the park in question.</td>
</tr>
<tr>
<td><strong>Victim Risk Level</strong></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Victim Resistance</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>Victim Impulsivity</strong></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Victim Self-esteem</strong></td>
<td>High</td>
</tr>
<tr>
<td><strong>Victim Mental Health</strong></td>
<td>Stable</td>
</tr>
<tr>
<td><strong>Victim Socioeconomic status</strong></td>
<td>Above average</td>
</tr>
<tr>
<td><strong>Victim Personality Variables</strong></td>
<td>The victim was described as confident and independent.</td>
</tr>
<tr>
<td><strong>Victim Intelligence</strong></td>
<td>Above average</td>
</tr>
<tr>
<td><strong>Victim Developmental History</strong></td>
<td>No irregularities</td>
</tr>
<tr>
<td><strong>UNSUB Intimate Knowledge of victim</strong></td>
<td>Not discernible</td>
</tr>
<tr>
<td><strong>UNSUB Contact with Relations/Authorities/Media</strong></td>
<td>No.</td>
</tr>
</tbody>
</table>
**UNSUB Deception/Manipulation.** Unlikely. Victim appears to have been approached from behind.

**Victim Similarity with Previous Victims** – Limited. Only similar factors appear to be gender and race.

**Window of Opportunity** – The offender had a fairly large window of time due to the secluded location.

**Victim Maintained for Length of Time** – Highly unlikely.

---

**Scenario 2 (Persons of Interest):**

**Person of Interest (A):**

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
</tr>
<tr>
<td>Age</td>
<td>50</td>
</tr>
<tr>
<td>Build/Body Type</td>
<td>Stocky build, 5ft 7 inches</td>
</tr>
<tr>
<td>Race</td>
<td>Caucasian</td>
</tr>
<tr>
<td>Criminal History</td>
<td>Sexual Assault</td>
</tr>
<tr>
<td>Criminal Sophistication</td>
<td>Unknown</td>
</tr>
<tr>
<td>Mental State/History</td>
<td>No irregularities</td>
</tr>
<tr>
<td>Familiarity with location</td>
<td>Local to the area</td>
</tr>
<tr>
<td>Relationship with Victim</td>
<td>None</td>
</tr>
<tr>
<td>Pre-event Stressors</td>
<td>Not discernible</td>
</tr>
<tr>
<td>Relationship Status/Living situation</td>
<td>Single, lives alone</td>
</tr>
<tr>
<td>Employment Type/History</td>
<td>Printer</td>
</tr>
<tr>
<td>Socioeconomic Status</td>
<td>Average</td>
</tr>
<tr>
<td>Routine/Lifestyle</td>
<td>Regular work hours</td>
</tr>
<tr>
<td>Post-Event Behaviours</td>
<td>No irregularities</td>
</tr>
<tr>
<td>Location of Residence/Work</td>
<td>Local to area</td>
</tr>
<tr>
<td>Personality Variables</td>
<td>Shy, introverted</td>
</tr>
<tr>
<td>Degree of Intelligence</td>
<td>Above average</td>
</tr>
<tr>
<td>Social Competency</td>
<td>Poor, withdrawn, no eye-contact</td>
</tr>
<tr>
<td>Anti-Social Behaviours</td>
<td>Unknown</td>
</tr>
<tr>
<td>Military History</td>
<td>No</td>
</tr>
<tr>
<td>Sexual Competency</td>
<td>Unknown</td>
</tr>
<tr>
<td>Vehicle Type</td>
<td>European car</td>
</tr>
<tr>
<td>Developmental History</td>
<td>Strict/aggressive parents</td>
</tr>
<tr>
<td>Interests/Affiliations</td>
<td>Undisclosed</td>
</tr>
<tr>
<td>Belief System/World View</td>
<td>No details</td>
</tr>
<tr>
<td>Addictive Behaviours</td>
<td>Unknown</td>
</tr>
<tr>
<td>Possession of Secure Site</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Person of Interest (B):**

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
</tr>
<tr>
<td>Age</td>
<td>32</td>
</tr>
<tr>
<td>Build/Body Type</td>
<td>Muscular, 6 ft 4 inches</td>
</tr>
</tbody>
</table>
Race – Caucasian
Criminal History – Assault
Criminal Sophistication – Unknown
Mental State/History – History of Bipolar disorder
Familiarity with location – Local to the area
Relationship with Victim – None
Pre-event Stressors – Not discernible
Relationship Status/Living situation – Single
Employment Type/History – Brick layer (labourer)
Socioeconomic Status – Average
Routine/Lifestyle – Early hours
Post-Event Behaviours – No irregularities
Location of Residence/Work – Local to area
Personality Variables – Highly confident, extroverted (perceived as arrogant)
Degree of Intelligence – Average
Social Competency – Good; charming
Anti-Social Behaviours – Unknown
Military History – No
Sexual Competency – Unknown
Vehicle Type – Motorcycle
Developmental History – No irregularities
Interests/Affiliations – Motorcycles
Belief System/World View – Undisclosed
Addictive Behaviours – Heavy use of alcohol
Possession of Secure Site – Yes

Person of Interest (C)

Gender – Male
Age – 37
Build/Body Type – Average
Race – Caucasian
Criminal History – On Parole, Break & Enter, and Sexual Assault
Criminal Sophistication – Unknown
Mental State/History – No irregularities
Familiarity with location – Neighbouring town
Relationship with Victim – None
Pre-event Stressors – Recent loss of job
Relationship Status/Living situation – Single
Employment Type/History – Ex-salesman
Socioeconomic Status – Average
Routine/Lifestyle – No regular routine
Post-Event Behaviours – No irregularities
Location of Residence/Work – Local to area
Personality Variables – Introverted
Degree of Intelligence – Average
Social Competency – Fair
Anti-Social Behaviours – Hostile towards police
Military History – No
Sexual Competency – Unknown
Vehicle Type – None
Developmental History – Raised by father only
Interests/Affiliations – Undisclosed
Belief System/World View – No details
Addictive Behaviours – Heavy smoker
Possession of Secure Site – Yes
A 25 year old, Caucasian woman has been found dead after being reported by her roommate as missing, 10 days prior. According to her room mate, the victim went to her car to retrieve textbooks at dusk and did not return. 10 days later, the victim’s body was found facedown on a highway roadside, in close proximity to a lake, approximately 260 miles (419 kms) from the abduction site. The victim had been beaten, raped, and sodomised, prior to death. The victim also had ligature marks on her wrists and ankles. Death resulted from multiple blows to the head with a blunt object. There is a noticeable absence of blood near the body. A number of cigarette butts have been found in one location at the abduction site (car park). Two previous crimes have been linked to the current case, each victim being of a similar appearance. A third female from another local college made a report to police of a man she had encountered in the car park of her university posing as a police officer. He was described as assertive and charming. As a result, the case has received a lot of media attention recently, including attempts to warn college students from the area. The victim attended classes on all week days, and had a part time job as a swim coach. The victim has been described as non-impulsive, average to high self-esteem, mentally stable, of average socioeconomic status, outgoing and energetic, above average intelligence, and having no developmental irregularities.
Scenario 3: (Explicit)
A 25 year old woman has been found dead after being reported by her college dorm roommate as missing, 10 days prior. The events of interest are as follows:

**Crime Classification** – Sexual Homicide

**Evidence of Fantasy** – Highly possible. A number of cigarette butts found in one location at the car park suggest that the victim may have been watched for some time.

**Transportation of Victim** – Yes. The victim was transported from the car park to an unknown location. She was then transported at least once more to the disposal site, which was approximately 260 miles (419 kms) from the abduction site.

**Serial Acts** – Yes. Two previous crimes have been linked to the current case. A third female from another local college made a report to police of a man she had encountered in the car park of her university posing as a police officer.

**Removal of Items from scene/victim** – Unknown.

**Verbal Behaviours** – From previous likely witness report, the man was very assertive, and charming.

**Positioning of victim body** – No discernible pattern.

**Staging** – Unlikely.

**Escalation** – No evidence.

**Depersonalisation of victim** – Victim had a beaten face, and found face down.

**Personalisation of victim** – Possible. All victims had similar appearance.

**Method of Body Concealment** – The victim was found near a lake; however, no obvious attempt to conceal the body.

**Ritualistic/Signature Behaviours** – None.

**Use of Restraints/Bondage** – Yes. Ligature marks around wrists and ankles.

**Point/Method of Entry** – n/a

**Concealment/Destruction of evidence** – No evidence.

**Level of Organisation** – Highly organised.

**Degree of Force used** – Extremely violent, but no overkill.

**Method of Approach** – According to the previous witness’s report, it is likely that the offender used a ruse to con victim during approach.

**Victim Selection** – Appears to be highly planned and based on a particular desired physical appearance.

**Time of Sexual/Violent Acts** – The victim was raped prior to her death.

**Torture/Sadistic Behaviours** – None.

**Injury Type/Locations** - The victim was sexually assaulted and beaten with a blunt object.

**Victim Age** – 25 years old.

**Victim Race** – Caucasian.

**Victim Routine** – The victim attended classes on all week days, and had a part time job as a swim coach.

**Victim Risk Level** - Fairly high; the case has received a lot of media attention recently, including attempts to warn college students.

**Victim Resistance** – Not discernible.

**Victim Impulsivity** – Low.

**Victim Self-esteem** – Average to high.
Victim Mental Health – Stable.
Victim Socioeconomic status – Average.
Victim Personality Variables – The victim was described as outgoing and energetic.
Victim Intelligence – Above average intelligence.
Victim Developmental History – No irregularities.
UNSUB Intimate Knowledge of victim – Not discernible.
UNSUB Contact with Relations/Authorities/Media – No.
UNSUB Deception/Manipulation. Likely that the victim used a ruse to con victim during approach.
Victim Similarity with Previous Victims – Yes. Previous victims were of a similar age and appearance.
Window of Opportunity – It appears that the offender waited until an appropriate victim was sighted.
Victim Maintained for Length of Time – Highly probable. The time which lapsed between abduction and the victim’s death was substantial. It is estimated that she was held for approximately 8 days, and has now been deceased for two.

Scenario 3 (Persons of Interest):

Person of Interest (A)

<table>
<thead>
<tr>
<th><strong>Gender</strong></th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>27</td>
</tr>
<tr>
<td><strong>Build/Body Type</strong></td>
<td>Average build, 6</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td>Caucasian</td>
</tr>
<tr>
<td><strong>Criminal History</strong></td>
<td>Theft, assault</td>
</tr>
<tr>
<td><strong>Criminal Sophistication</strong></td>
<td>Unknown</td>
</tr>
<tr>
<td><strong>Mental State/History</strong></td>
<td>No irregularities</td>
</tr>
<tr>
<td><strong>Familiarity with location</strong></td>
<td>From bordering state (approximately 320 Miles from disposal site, 130 miles from abduction site).</td>
</tr>
<tr>
<td><strong>Relationship with Victim</strong></td>
<td>None.</td>
</tr>
<tr>
<td><strong>Pre-event Stressors</strong></td>
<td>Rejected by previous partner.</td>
</tr>
<tr>
<td><strong>Relationship Status/Living situation</strong></td>
<td>One previous long-term relationship.</td>
</tr>
<tr>
<td><strong>Employment Type/History</strong></td>
<td>Pursuing politics.</td>
</tr>
<tr>
<td><strong>Socioeconomic Status</strong></td>
<td>Average</td>
</tr>
<tr>
<td><strong>Routine/Lifestyle</strong></td>
<td>Attends classes twice a week</td>
</tr>
<tr>
<td><strong>Post-Event Behaviours</strong></td>
<td>No irregularities</td>
</tr>
<tr>
<td><strong>Location of Residence/Work</strong></td>
<td>Not local.</td>
</tr>
<tr>
<td><strong>Personality Variables</strong></td>
<td>Extroverted, confident.</td>
</tr>
<tr>
<td><strong>Degree of Intelligence</strong></td>
<td>Above average intelligence</td>
</tr>
<tr>
<td><strong>Social Competency</strong></td>
<td>High. Charming.</td>
</tr>
<tr>
<td><strong>Anti-Social Behaviours</strong></td>
<td>Not discernible.</td>
</tr>
<tr>
<td><strong>Military History</strong></td>
<td>No.</td>
</tr>
<tr>
<td><strong>Sexual Competency</strong></td>
<td>Undisclosed.</td>
</tr>
<tr>
<td><strong>Vehicle Type</strong></td>
<td>Pickup truck (ute).</td>
</tr>
<tr>
<td><strong>Developmental History</strong></td>
<td>Believed grandparents were his parents.</td>
</tr>
</tbody>
</table>
**Interests/Affiliations** – Politics.
**Belief System/World View** – Undisclosed.
**Addictive Behaviours** – No.
**Possession of Secure Site** – Yes.

---

**Person of Interest (B)**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>26</td>
</tr>
<tr>
<td>Build/Body Type</td>
<td>Average build, 6 ft 2 inches.</td>
</tr>
<tr>
<td>Race</td>
<td>Caucasian</td>
</tr>
<tr>
<td>Criminal History</td>
<td>Minor assault charges</td>
</tr>
<tr>
<td>Criminal Sophistication</td>
<td>Unknown</td>
</tr>
<tr>
<td>Mental State/History</td>
<td>No irregularities</td>
</tr>
<tr>
<td>Familiarity with Location</td>
<td>Local to crime scene.</td>
</tr>
<tr>
<td>Relationship with Victim</td>
<td>None (found victim).</td>
</tr>
<tr>
<td>Pre-event Stressors</td>
<td>Not discernible.</td>
</tr>
<tr>
<td>Relationship Status/Living Situation</td>
<td>Divorced. Single.</td>
</tr>
<tr>
<td>Employment Type/History</td>
<td>Truck driver.</td>
</tr>
<tr>
<td>Socioeconomic Status</td>
<td>Average</td>
</tr>
<tr>
<td>Routine/Lifestyle</td>
<td>Works late shifts.</td>
</tr>
<tr>
<td>Post-Event Behaviors</td>
<td>No irregularities</td>
</tr>
<tr>
<td>Location of Residence/Work</td>
<td>Frequent travel.</td>
</tr>
<tr>
<td>Personality Variables</td>
<td>Extroverted, aggressive</td>
</tr>
<tr>
<td>Degree of Intelligence</td>
<td>Average intelligence</td>
</tr>
<tr>
<td>Social Competency</td>
<td>Moderate to high.</td>
</tr>
<tr>
<td>Anti-Social Behaviours</td>
<td>No.</td>
</tr>
<tr>
<td>Military History</td>
<td>No.</td>
</tr>
<tr>
<td>Sexual Competency</td>
<td>Yes.</td>
</tr>
<tr>
<td>Vehicle Type</td>
<td>Truck (work), pickup (Ute) (home).</td>
</tr>
<tr>
<td>Developmental History</td>
<td>No irregularities</td>
</tr>
<tr>
<td>Interests/Affiliations</td>
<td>Sports, hunting.</td>
</tr>
<tr>
<td>Belief System/World View</td>
<td>Undisclosed.</td>
</tr>
<tr>
<td>Addictive Behaviours</td>
<td>Smoking.</td>
</tr>
<tr>
<td>Possession of Secure Site</td>
<td>Yes.</td>
</tr>
</tbody>
</table>

---

**Person of Interest (C)**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>25</td>
</tr>
<tr>
<td>Build/Body Type</td>
<td>Average build, 5 ft 10 inches.</td>
</tr>
<tr>
<td>Race</td>
<td>Caucasian</td>
</tr>
<tr>
<td>Criminal History</td>
<td>None.</td>
</tr>
<tr>
<td>Criminal Sophistication</td>
<td>Unknown</td>
</tr>
<tr>
<td>Mental State/History</td>
<td>No irregularities</td>
</tr>
<tr>
<td>Familiarity with Location</td>
<td>Local to abduction site.</td>
</tr>
</tbody>
</table>
**Relationship with Victim** – Boyfriend (Short-term).

**Pre-event Stressors** – Not discernible.

**Relationship Status/Living situation** – In relationship; Lives with parents.

**Employment Type/History** – Student.

**Socioeconomic Status** - average

**Routine/Lifestyle** – Classes three times a week.

**Post-Event Behaviours** – Absent from classes.

**Location of Residence/Work** – Local to abduction site.

**Personality Variables** – Introverted.

**Degree of Intelligence** – Above average intelligence

**Social Competency** – Moderate.

**Anti-Social Behaviours** – None.

**Military History** – No.

**Sexual Competency** – Yes.

**Vehicle Type** – None.

**Developmental History** – No irregularities.

**Interests/Affiliations** – Law Society, Social Justice Group.

**Belief System/World View** – Undisclosed.

**Addictive Behaviours** – None.

**Possession of Secure Site** – No.
Scenario 4 (Graphic):

Scenario 4 (Implicit):

A 21 year old, Caucasian female has been found murdered in her apartment. The victim was found lying in her bedroom, face up, dressed only in underwear bottoms. A bloodied knife, with bent tip, was found close to the body. There are no signs of forced entry to the apartment, however, blood has been found on the doorknob. Large amounts of blood are evident on the victim’s torso and crotch. Death was caused by multiple stab wounds (approx. 40), almost half of which were around the victim’s breast region. There is also heavy bruising on her neck, upper right thigh, and face. She also had bruises and cuts to her hands. The crime appears to have taken place during daylight hours, in a heavily populated area. A homicide had occurred in the previous week, with a similar MO and display of Piquerism (overkill by means of stabbing). The victim appears to have been sun tanning at the time of the attack. The victim was not sexually assaulted. The victim and was said to be independent and confident, non-impulsive, mentally stable, of high self-esteem, of average intelligence, with no developmental irregularities. The victim worked part-time (late nights) as an exotic dancer.
Scenario 4 (Explicit):
A 21 year old Caucasian female has been found murdered in her apartment. The Events of Interest are as follows:

- **Crime Classification** – Homicide
- **Evidence of Fantasy** – Yes. Knife wounds around breast area may resemble entry of Penis.
- **Transportation of Victim** – No. Kill site and disposal site are the same.
- **Serial Acts** – Yes. A homicide had occurred in the previous week, with a similar MO and display of Pikerism (overkill by means of stabbing)
- **Removal of Items from scene/victim** – No.
- **Verbal Behaviours** – Unknown.
- **Positioning of victim body** – Found lying in her bedroom, face up, only in bikini bottoms.
- **Staging** – No evidence.
- **Depersonalisation of victim** – No evidence.
- **Personalisation of victim** – No evidence.
- **Method of Body Concealment** – None.
- **Ritualistic/Signature Behaviours** – Pikerism: overkill by means of stabbing and gouging with a sharp instrument.
- **Use of Restraints/Bondage** – No.
- **Point/Method of Entry** – No signs of forced entry.
- **Concealment/Destruction of evidence** – No.
- **Level of Organisation** – Low to medium. Although the offender demonstrated a minor degree of organisation in entering the building, he/she did not attempt to conceal evidence (e.g., the murder weapon).
- **Degree of Force used** – High. Extremely violent and excessive.
- **Method of Approach** – Appears to be a surprise attack while sun tanning.
- **Victim Selection** – Appears to be opportunistic in nature.
- **Time of Sexual/Violent Acts** – No sexual acts.
- **Torture/Sadistic Behaviours** – Sadistic behaviours; Offender appears to be stimulated by violence.
- **Injury Type/Locations** – 40 stab wounds, almost half of which around her breasts
  Heavy bruising on her neck and upper right thigh, and face.
- **Victim Age** – 21 years old.
- **Victim Race** – Caucasian.
- **Victim Routine** – The victim works as a part time (late night) exotic dancer.
- **Victim Risk Level** – Medium to high (attack took place in highly populated area, and in daylight).
- **Victim Resistance** – Yes. Bruises and cuts found on the victim’s hands.
- **Victim Impulsivity** – Low.
- **Victim Self-esteem** – High.
- **Victim Mental Health** – Stable.
Victim Socioeconomic status – Average.
Victim Personality Variables – The victim was described as confident and independent.
Victim Intelligence – Average.
Victim Developmental History – No irregularities.
UNSUB Intimate Knowledge of victim – Not discernible.
UNSUB Contact with Relations/Authorities/Media – No.
UNSUB Deception/Manipulation – Possible. No signs of forced entry.
Victim Similarity with Previous Victims – N/A
Window of Opportunity – Limited.
Victim Maintained for Length of Time - No.

Scenario 4 (Persons of Interest):

Person of Interest (A)

- Gender - Male
- Age - 30
- Build/Body Type – slight to average, 5ft 9 inches
- Race – Caucasian
- Criminal History – Break and enter, theft.
- Criminal Sophistication – Moderate (previous break and enters)
- Mental State/History – No irregularities
- Familiarity with location – Local to the area
- Relationship with Victim – None.
- Pre-event Stressors – None.
- Relationship Status/Living situation – Single.
- Employment Type/History – Mechanic
- Socioeconomic Status - average
- Routine/Lifestyle – Works early morning to afternoon hours.
- Post-Event Behaviours – Absent from work
- Location of Residence/Work - Local
- Personality Variables – Confident, outgoing
- Degree of Intelligence – Average to above average
- Social Competency – Very good, polite.
- Anti-Social Behaviours – Not discernible.
- Military History – Navy; dishonourable discharge.
- Sexual Competency – Ex-girlfriend reports erectile dysfunction.
- Vehicle Type – None.
- Developmental History – No irregularities.
- Interests/Affiliations - Cars
- Belief System/World View - undisclosed
- Addictive Behaviours - Pornography
- Possession of Secure Site – Yes. Rented apartment.
### Person of Interest (B)

**Gender** - Male  
**Age** - 29  
**Build/Body Type** – Slight to average build, 5ft 9 inches  
**Race** – African American  
**Criminal History** – Break and enter  
**Criminal Sophistication** – Low  
**Mental State/History** – No irregularities  
**Familiarity with location** – Local to the area  
**Relationship with Victim** – None  
**Pre-event Stressors** – Not discernible.  
**Relationship Status/Living situation** – Short-term relationship, shares apartment with roommate  
**Employment Type/History** – Fast food restaurant  
**Socioeconomic Status** – Low to average  
**Routine/Lifestyle** – Works early morning to afternoon hours.  
**Post-Event Behaviours** – as per usual  
**Location of Residence/Work** – Local to crime  
**Personality Variables** - Confident, quick to anger  
**Degree of Intelligence** - Average  
**Social Competency** - Good  
**Anti-Social Behaviours** – None  
**Military History** – None  
**Sexual Competency** – Reports to be normal/active  
**Vehicle Type** - None  
**Developmental History** – No irregularities  
**Interests/Affiliations** – Undisclosed,  
**Belief System/World View** – High racial prejudice  
**Addictive Behaviours** - None  
**Possession of Secure Site** - No

### Person of Interest (C)

**Gender** - Male  
**Age** - 22  
**Build/Body Type** – Large build, 6 ft  
**Race** – Caucasian  
**Criminal History** – None  
**Criminal Sophistication** – Unknown  
**Mental State/History** – No irregularities  
**Familiarity with location** – Local to the area  
**Relationship with Victim** – Boyfriend.  
**Pre-event Stressors** – Not discernible.
Relationship Status/Living situation – Intimate relationship with victim, lived alone.
Employment Type/History – Business student
Socioeconomic Status - average
Routine/Lifestyle – Based on class hours
Post-Event Behaviours – as per usual
Location of Residence/Work – Local to crime scene
Personality Variables – Introverted
Degree of Intelligence – Above average
Social Competency - Good
Anti-Social Behaviours - None
Military History – None.
Sexual Competency - Undisclosed
Vehicle Type – Toyota Corolla
Developmental History – No irregularities
Interests/Affiliations - Gambling
Belief System/World View - Catholic
Addictive Behaviours – None
Possession of Secure Site – Yes.