Running head: JURY DECISION-MAKING IN DNA CASES

**The Relationship Between Beliefs, Strength of Evidence, Statistical Presentation,
and Expert Testimony on Jury Decision-Making in DNA Cases**

by

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Abstract

According to the literature on jury decision-making, many factors account for how jurors reach a final verdict decision in criminal trials, including their pre-conceived beliefs about evidence. Given the recent popularity of DNA evidence, it is important to understand the factors that influence jurors' verdict decisions in criminal cases where DNA evidence is involved. Besides jurors' beliefs about DNA, other potentially important factors include strength of the evidence (SOE), expert testimony, and how DNA evidence is statistically presented. These factors were examined across two studies. Participants in Study 1 were 71 undergraduate university students who were selected to take part in a mock-jury study based on their responses to a questionnaire assessing their beliefs about DNA. After reading a transcript of a mock murder trial in which SOE was manipulated, jurors were required to rate various aspects of the case and to give a verdict rating. Results found no interaction between jurors' pre-existing beliefs about DNA and SOE. However, SOE impacted on jurors' verdict decisions with stronger DNA evidence leading to higher ratings of guilt than weaker DNA evidence. Participants in Study 2 were 228 undergraduate university students who agreed to take part in a mock jury study. They read a transcript of a mock murder trial manipulating SOE, expert testimony, and type of statistical presentation of DNA evidence. Jurors then rated various aspects of the case and gave a verdict rating. Results again found that when trial evidence was strong rather than weak, jurors gave higher guilt ratings. Furthermore, higher ratings of guilt, expert persuasiveness and usefulness of expert testimony were given by jurors who read DNA error rates presented as frequencies versus probabilities or ratios. There was also a

significant interaction between type of expert testimony and statistical presentation.

When expert testimony addressed how statistical information about DNA error rates can be presented in different, yet equivalent ways, jurors who read frequency error rates gave higher guilt ratings than those who read probability or ratio error rates. Overall, the results highlight the importance of ensuring that jurors are accurately educated about DNA evidence before entering the courtroom.

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Table of Contents

Abstract.....	ii
Acknowledgements.....	iv
Table of Contents.....	v
List of Tables	viii
List of Figures.....	ix
List of Appendices.....	x
Models of Jury Decision-Making	3
<i>Traditional Models</i>	3
<i>The Story Model</i>	5
<i>Tests of the Story Model</i>	11
The Impact of DNA Evidence on Jurors	20
Strength of Evidence and Juror Beliefs	24
Statistical Presentation of DNA Evidence.....	32
The Impact of Expert Testimony on Jury Decision-Making.....	38
Purpose of the Present Study and Research Hypotheses.....	46
Method (Study 1).....	50
<i>Participants</i>	50
<i>Materials</i>	51
<i>Procedure</i>	57
<i>Design and Proposed Analyses</i>	58
Results	58

<i>Data Screening</i>	58
<i>Manipulation Checks</i>	59
<i>Strength of Evidence and Beliefs About DNA</i>	60
<i>Pre and Post DNA Beliefs</i>	63
Discussion.....	63
Method (Study 2).....	68
<i>Participants</i>	68
<i>Materials</i>	69
<i>Procedure</i>	71
<i>Design and Proposed Analyses</i>	72
Results	72
<i>Data Screening</i>	72
<i>Manipulation Checks</i>	74
<i>Strength of Evidence, Expert Testimony, and Statistical Presentation</i>	74
Discussion.....	83
General Discussion	87
<i>Implications</i>	88
<i>Limitations</i>	91
<i>Future Research</i>	93
Conclusion	95
References.....	96
Appendix A.....	104

Appendix B.....	107
Appendix C.....	108
Appendix D.....	123
Appendix E.....	138
Appendix F.....	154
Appendix G.....	155
Appendix H.....	156
Appendix I.....	157
Appendix J.....	158
Appendix K.....	159
Appendix L.....	160
Appendix M.....	161
Appendix N.....	162
Appendix O.....	177
Appendix P.....	179
Appendix Q.....	180

List of Tables

Table 1: Correlations Between Items Measuring DNA Beliefs at Pre-test	53
Table 2: Means and Standard Errors for Manipulation Check Variables (Study 1).....	61
Table 3: Means (SE) for DNA Beliefs on all Dependant Variables.....	62
Table 4: Means (SE) for Strength of Evidence on all Dependant Variables (Study 1)	64
Table 5: Correlations Between Items Measuring DNA Beliefs at Post-test.....	65
Table 6: Means and Standard Errors for Manipulation Check Variables (Study 2).....	75
Table 7: Means (SE) for Strength of Evidence on all Dependant Variables (Study 2)	78
Table 8: Means (SE) for Expert Testimony on all Dependant Variables	79
Table 9: Means (SE) for Statistical Presentation on all Dependant Variables	80

List of Figures

Figure 1: Episode Schema Components	7
Figure 2: The Story Model for Juror Decision-Making.....	10
Figure 3: Graph of Significant Interaction Between Type of Expert Testimony and Statistical Presentation.....	81

List of Appendices

Appendix A: DNA Beliefs.....	104
Appendix B: Exclusionary Criteria for Jury Service in Ontario	107
Appendix C: Strong DNA	108
Appendix D: Weak DNA.....	123
Appendix E: Ambiguous DNA.....	138
Appendix F: Ratings of Strength of DNA Against the Defendant	154
Appendix G: Ratings of Strength of Prosecution's Case.....	155
Appendix H: Ratings of Strength of Defendant's Case.....	156
Appendix I: Verdict Ratings.....	157
Appendix J: Verdict Confidence Ratings	158
Appendix K: Ratings of Expert Witness Credibility	159
Appendix L: Ratings of Expert Witness Persuasiveness.....	160
Appendix M: Ratings of Expert Witness Usefulness	161
Appendix N: Case Summary (Study 2)	162
Appendix O: Summary of Evidence in Favour of Defense and Crown	177
Appendix P: Ratings of Ease of Understanding of Statistical Information.....	179
Appendix Q: List of Acronyms Used	180

**The Relationship Between Beliefs, Strength of Evidence, Statistical
Presentation, and Expert Testimony on Jury Decision-Making in DNA Cases**

In order for any jury trial to be fair, there is an expectation that jurors will be open-minded when evaluating the evidence that is presented to them (Carlson & Russo, 2001; Department of Justice Canada, 2005; Devine, Clayton, Dunford, Seying, & Pryce, 2001). However, jurors come into the courtroom with their own attitudes, expectations, personalities and beliefs (Huntley & Costanzo, 2003; Shestowsky & Horowitz, 2004; Weinstock & Flaton, 2004). It may be unrealistic to expect that jurors can simply “switch off” their beliefs when evaluating evidence in a trial, and indeed, available research supports this notion (i.e., Pennington & Hastie, 1986, 1988). The purpose of the present research is to examine how jurors’ beliefs about DNA evidence influence their verdicts in criminal trials. Furthermore, this research will examine how beliefs about the meaning of DNA statistics impact on jury decision-making and whether expert scientific testimony can help to clarify the meaning of DNA statistics.

According to the Story Model of jury decision-making (i.e., the model that suggests that jurors try to compose a story of what happened during a crime and how the evidence fits within that story; Pennington & Hastie, 1986, 1988), jurors use their related world knowledge, beliefs, and expectations in combination with the evidence presented when forming causal explanations about that evidence. Research using the Story Model has investigated how jurors use story structures during a trial to reach an ultimate verdict (Pennington & Hastie, 1992, 1993). Given the increasing frequency with which DNA evidence is used in criminal trials, it is important to examine how jurors’ knowledge,

beliefs, and expectations about this particular type of evidence impact on their verdict decisions.

Research on decision-making in DNA cases reveals that jurors do not always understand statistical probability estimates or combination rules (Taroni & Aitken, 1997). As a result, jurors may find statistical evidence to be confusing or weak and they may therefore end up relying more on their beliefs in reaching a verdict rather than on the strength and merit of the DNA evidence itself. Research examining human reasoning under uncertainty both in general and in DNA cases indicates that statistical frequency formats (i.e., “1 in 1000”) appear to be more easily understood than probabilities (i.e., “0.1%”) or likelihood ratios (i.e., “1000:1”) even when the values presented for the different formats are statistically equivalent (Gigerenzer & Hoffrage, 1995; Koehler, 1996). Relating to jurors in DNA cases, it is important to examine what can be done to make the statistical presentation of evidence less confusing and to counteract the potentially false beliefs jurors might have about the meaning of statistical information. Perhaps expert testimony can help in this regard.

Research examining the impact of expert testimony on jury decision-making in battered-women trials indicates that such testimony can help to counteract false beliefs that jurors may hold (Schuller, McKimmie, & Janz, 2004; Schuller, Smith, & Olson, 1994). However, it is unclear to what extent jurors’ beliefs about DNA evidence might influence their decision-making and to what extent jurors incorporate expert testimony in DNA cases as part of their decision-making. Furthermore, the extent of the relationship between the strength of DNA evidence and the statistical presentation of that evidence

has not been clearly established. Similarly, the impact of expert testimony as a tool for clarifying statistical confusions that jurors might have, and hence, addressing beliefs they may hold about the meaning of statistics, has not been examined. These are important issues to consider because if indeed jurors' beliefs impact on their verdict choices, the fairness of the trial could be jeopardized.

This research examined how mock jurors' beliefs about DNA evidence influenced their decision making in criminal trials. Two studies were conducted. In the first study, the impact of beliefs regarding DNA evidence on jury decision making was examined in light of whether the trial evidence presented was weak, strong, or ambiguous. The second study explored the relationship between statistical presentation of DNA evidence, strength of evidence, and the impact of expert testimony in helping to clarify the meaning of DNA statistics for jurors. Before proceeding with the research hypotheses and methodology, a literature review of the Story Model of jury decision making is presented, as well as a brief summary of research examining the impact of DNA evidence on jurors. A review of the literatures examining the impact of strength of evidence on jury decision making, statistical presentation of DNA evidence, and the impact of expert testimony on jury decision making is also included.

Models of Jury Decision-Making

Traditional Models

Research examining psychological and mathematical models of jury decision-making primarily emerged in the 1970's and early 1980's (i.e., Pennington & Hastie, 1981; Penrod & Hastie, 1979). The main goals of this research were to gain insight into

the cognitions of adults engaged in complex and naturally occurring reasoning tasks, to extend pre-existing psychological models, and to provide useful empirical data to the legal community (Pennington & Hastie, 1981).

In the beginning, there were four predominant models that attempted to account for jury decision-making¹. The first is the information integration model that proposes that jurors evaluate all evidence and information items independently and then weight and average them at the end of the trial to determine whether the defendant is guilty (Kaplan & Kemmerick, 1974; Ostrom, Werner, & Saks, 1978). Second, the Bayesian models (Schum, 1975; Schum & DuCharme, 1971) describe juror decision making as a task in which jurors begin with some prior notion of the defendant's guilt. Each time a new piece of evidence is presented, the jurors' prior notions are revised depending on how supportive the evidence is of the defendant's guilt. The end verdict is therefore viewed as a multiplicative product of the jurors' prior notions (opinions) and the diagnosticity of each separate piece of evidence (Pennington & Hastie, 1986). Third, the Poisson model (Thomas & Hogue, 1976) proposes that the juror's task involves a two-step process. In the first step, each juror evaluates the evidence for and against the defendant that combines to form a final estimate of the weight of the case against the defendant. In the second step, each juror compares the apparent weight of the evidence to his or her own decision criterion that serves to divide the potential range of apparent weight into 'for' and 'against' decision regions in order to arrive at a decision of "guilty" or "not guilty" (Pennington & Hastie, 1981). More specifically, jurors decide 'for' the

¹ The four traditional models are only very briefly described here so as to set the stage for how the Story Model came to be. A lengthier description is beyond the scope of this research.

plaintiff or defendant if the apparent weight of the evidence is less than the decision criterion and they decide 'against' the plaintiff or defendant if the apparent weight of the evidence is greater than the decision criterion. The decision criterion varies from case to case (Thomas & Hogue, 1976). Finally, with the sequential weighting model, jury decision-making is viewed as a series of opinion changes (Anderson, 1959; Einworth & Hogarth, 1985). These opinion changes occur during the trial and are conditioned by the current evidence being presented as well as jurors' previous judgments. This process continues until a final verdict is reached (Pennington & Hastie, 1981).

Pennington and Hastie (1986) concluded that while the traditional models contributed to a better understanding of the jury decision-making process, they were insufficient to account for many of the aspects associated with realistic and complex legal decisions. For example, Pennington and Hastie (1986) stated that jury decisions do not show a continuous updating pattern across evidence presentation, that interdependencies among evidence items occur frequently, that jurors often make inferences about missing or unstated information, that when jurors are uncertain, their reasoning patterns cannot be explained by conventional probability theory, and that the final stages of the decision-making process involve reasoning about multiattribute verdict categories as opposed to only one dimension of culpability. In order to address these issues, Pennington and Hastie (1986) developed and tested the Story Model of jury decision-making.

The Story Model

According to the Story Model, jurors impose a narrative story organization on the information they receive during a trial based on the causal and intentional relations

between events. It is believed that the stories organized by jurors allow them not only to understand the evidence that is presented, but also to reach a predeliberation verdict (Hastie & Pennington, 2000; Pennington & Hastie, 1986, 1988). Jurors may construct more than one story, however, one story will usually be accepted as more coherent than the others (Pennington & Hastie, 1988). Jurors assess coherence in terms of the completeness, consistency, and plausibility of the story where completeness is the extent to which a story has all of its parts, consistency is the extent to which a story does not contradict itself, and plausibility judgments involve comparing the story sequences to known or imagined real world events. There are three main components to the Story Model, namely story construction, verdict category establishment, and story classification. These are subsequently described.

Story construction. According to Pennington and Hastie (1986), story construction occurs both during and after the presentation of evidence in a trial. In order to assign meaning to the evidence, jurors incorporate that evidence into one or several possible accounts (stories) describing what happened during the events being testified to. Jurors use general knowledge about human action sequences and behaviour in order to form an episode schema that in turn allows them to organize events according to their causal and intentional interrelationships. As shown in Figure 1, episode schemas consist of events that initiate a person's psychological state and motives or goals that provide reasons for that person's actions that ultimately result in a specific outcome or consequence. Besides the person's psychological or mental condition, his/her physical condition, as related to the circumstances of the event, is also a part of the episode

Figure 1. Episode schema components. From Pennington and Hastie (1986).

schema in one of two ways: a) as the person's current physical state at the time of the initiating events that enabled that person to engage in specific actions (i.e., in the case where a person is intoxicated and starts a bar brawl that escalates to the point where he kills someone) or, b) as a result of the initiating events and thus leading to the initiation of the psychological state, motives, or goals (i.e., if a person is standing in line at a bank machine, and after getting hit from behind, becomes fearful for his life, turns around, fights with the assailant and ends up killing him). In the former example, the person's physical condition causes the initiating event that leads to the killing while in the latter example, the person's physical condition (i.e., pain from being attacked) is a result of the initiating event and ultimately leads to the killing of the assailant.

Verdict category establishment. During verdict category establishment, Pennington and Hastie (1986) propose that jurors learn of and come to understand the decision alternatives. This information is usually presented at the end of the trial in the instructions on the law given by the judge. In criminal cases, jurors form a representation of each verdict alternative as a category with specific defining features along with decision rules regarding their appropriate combination. The defining features refer to the identity, mental state, circumstances, and actions linked to each verdict alternative. One example given by Pennington and Hastie (1986) is that a defendant is guilty of first-degree murder if the defendant is the person who killed the victim (identity), if the killing occurred by the defendant in pursuance of resolution to some sort of dispute or problem (action), if the defendant had insufficient provocation (circumstance), and if the defendant had a purpose and intent to kill (mental state). However, a defendant is

deemed to have acted in self defense if the defendant is the person who killed the victim (identity), if the defendant used reasonable force (actions), was unable to escape (circumstances), and was in fear of his/her life or of great bodily harm (mental state). All other possible verdict categories, such as second-degree murder and manslaughter, also have specific defining features.

Story classification. During story classification, Pennington and Hastie (1986) state that jurors make a judgment by means of a classification process that allows them to determine a best match between story features and verdict category features. During the classification process, episode schema components are related to verdict categories. That is, identity, mental state, circumstances, and actions are closely related to initiating events, goals, actions, and psychological and physical states as outlined in Figure 1. In order to classify a story into the appropriate verdict category, jurors must critically interpret, process, and organize the evidence in a meaningful way. They must also apply the judge's procedural instructions on the presumption of innocence and the standard of proof (i.e., that the defendant is guilty beyond a reasonable doubt). In most circumstances, jurors are supposed to apply the standard of proof individually to each element of the verdict, however, jurors instead appear to make a global judgment (Pennington & Hastie, 1986). They make preliminary evaluations of plausibility based on story completeness and coherence, and then make a final verdict decision based on the goodness-of-fit of the story to the verdict category. Figure 2 summarizes the Story Model and its components.

Figure 2. The Story Model for juror decision making. Adapted from Pennington and Hastie (1992).

While the Story Model appeared to be theoretically viable, empirical research was needed to test its practical utility in jury decision-making contexts. As a result, several studies of the Story Model were undertaken.

Tests of the Story Model

In order to assess whether jurors' mental representations of evidence actually do assume a story structure, Pennington and Hastie (1986) studied 26 adults (12 women and 14 men; *M* age = 47 years) who were randomly selected from over 200 volunteers from an American jury pool. In groups of four, the participants watched a three hour videotaped reenactment of a murder trial in which the defendant was being charged of first-degree murder and they were informed that they would be asked to act as jurors. Afterwards, each juror was interviewed individually and asked to talk aloud about the case and about his/her verdict decision. Jurors were asked to choose among four verdict alternatives: not guilty, guilty of manslaughter, guilty of second-degree murder, or guilty of first-degree murder.

Using content analysis, Pennington and Hastie (1986) found that the spontaneous interview protocols of the jurors did exhibit story structure features with causal event chains and episode structures. Jurors' stories were not simply lists of evidence but instead generally contained the episode schema components of initiating events, psychological and physical states, goals, actions, and consequences. When components were not contained in the direct trial testimony, jurors tended to infer the necessary information. Furthermore, when evidence was unrelated to the jurors' stories, it was generally not discussed. The jurors' stories also contained events and goals that were

related to features of the verdict categories designated as legal elements of the charge against the defendant.

Pennington and Hastie (1986) also found that jurors' stories varied systematically in content and structure depending on their verdict choice. The goals and mental states of the defendant were described differently, corresponding to the specific legal requirements of the verdict categories chosen by the jurors. Similarly, there were major differences in the central stories and organization of evidence of jurors who chose different verdicts. When causal event chains and episode structures overlapped across verdict categories, jurors still showed different elaboration and causal-link patterns.

In a set of two experiments, Pennington and Hastie (1988) found further evidence of an explanation (story) based model of jury decision-making. The purpose of the first experiment was to determine whether jurors' mental representations resembling stories are constructed spontaneously without experimenter prompts to discuss the evidence or the decision. This experiment also tested whether perceived importance of evidence items could be predicted from the role of each evidence item in the story structure as per prior research conducted by Trabasso and Sperry (1985) and Trabasso and van den Broek (1985). Participants included 34 college students from a Psychology subject pool. Using verdict stories derived from their 1986 interview study, Pennington and Hastie (1988) classified 119 evidence items (i.e., sentences attributed to a series of witnesses) as either being associated with or not associated with the particular story types. Items were considered to be an assertion of the guilty murder verdict or the not guilty (self-defense) verdict when at least 80% of participants who had chosen the same verdict in the 1986

study had endorsed the items and their associated events. Some of the 119 items overlapped across both the guilty and not guilty stories, and some were associated with neither story.

All instructions and stimulus materials were read by participants on a computer. They read a shorter version of the murder trial from Pennington and Hastie's (1986) previous study that included the indictment, 119 evidence items (presented one at a time), and the judge's instructions on the law. Participants were asked to indicate a verdict decision and after doing so were given instructions for a recognition memory task in which they were shown 93 sentences. The purpose of this task was to determine whether participants could discriminate between evidence items that they had versus had not already been exposed to in the first task. After each sentence, participants had to indicate whether they recognized it from the original evidence. Finally, the participants were asked to rate each sentence presented as evidence for its importance in their verdict decision.

Results indicated that 85% of the time, participants correctly recognized test sentences referring to evidence and events in their "own" verdict story. However, when participants were given test sentences that had been presented as evidence, but referred to events in the "other" verdict story, their correct recognition rate was slightly lower (79%). Interestingly, participants falsely recognized lure test sentences that referred to predicted inferences (as opposed to actual events) 29% of the time, but to events in neither story only 7% of the time. Furthermore, evidence items that were part of the story corresponding to the participants' verdict choices were rated as significantly more

important than items from the opposition story. These results were taken as support for the notion that jurors spontaneously construct story structure summaries of trial evidence without having to be prompted by interview questions and that this story structure serves as a retrieval system for associated memory tasks (Pennington & Hastie, 1988).

In the second experiment, Pennington and Hastie (1988) manipulated the order of the evidence presentation in the trial so that the prosecution and defense stories were either easy or difficult to construct. This was done in order to examine the temporal order of story construction (i.e., pre or post verdict) with the supposition that if difficulty of story construction influences verdict, that stories must be formed before verdicts are chosen. That is, if stories that are difficult to construct impact on verdict decisions, jurors must form these stories *before* they select a verdict as opposed to forming the stories after the fact as a means of justifying their verdict choice. Easy to construct stories were presented in story order that preserves temporal and causal order between evidence items while difficult to construct stories were presented in witness by witness order that generally disrupts the natural causal and temporal order of events. Using the materials from the first experiment, two versions of the defense evidence and two versions of the prosecution evidence (one in story order and one in witness order for each) were developed and tape recorded. These were crossed to form four experimental groups: a) both defense and prosecution evidence in story order, b) defense evidence in story order and prosecution evidence in temporal order, c) defense evidence in temporal order and prosecution evidence in story order, and d) both defense and prosecution evidence in temporal order.

Participants were 130 undergraduate and graduate students from two American universities. They were tested in groups of 2 to 10 participants and were assigned to one of the four experimental groups. They listened to the tape recorded evidence and were asked to render a verdict and to answer questions about the case. Overall, 78% of participants gave a guilty verdict when the prosecution evidence was presented in story order and the defense evidence in temporal order, but only 31% gave a guilty verdict when the defense evidence was in story order and the prosecution evidence in temporal order. When both or neither side was presented in story order, comparable levels of guilty verdicts resulted (59% vs. 63%, respectively). Furthermore, participants perceived both prosecution and defense evidence as stronger when they were presented in story order as opposed to temporal order. Participants were most confident in their verdicts when they heard both the defense and prosecution evidence in story order, followed by participants who heard only the prosecution evidence in story order, then participants who heard only the defense evidence in story order, and finally, participants who heard neither set of evidence in story order. Pennington and Hastie (1988) concluded that jury decision-making does indeed take an explanation or story-based approach in which a summary representation of evidence is formed, retained in memory, and ultimately used to come up with a verdict. Moreover, this process does not appear to be algebraic or probabilistic in nature as suggested by the traditional models, but instead is structured semantically through causal relations among important events.

One criticism of the previous study is that evidence presented in story order (as opposed to temporal order) could have resulted in better memory for that body of

evidence, thus making it more readily available when a verdict decision had to be made (Pennington & Hastie, 1988). In order to address this possible limitation, Pennington and Hastie (1992) conducted another experiment in which they manipulated the ease of story construction by varying the order of evidence presentation. However, in this study, they used simpler materials that had been shown in past research (i.e., Devine & Ostrom, 1985) to be equally memorable in terms of evidence organization. The study also varied the credibility of one of the witnesses in order to test whether story organization of evidence increases the impact of credibility information on decisions. Participants were 414 university undergraduates in a psychology class who were randomly assigned to one of 24 conditions varying the credibility of the witness (low credibility, high credibility, no credibility information), the evidence order (by story or by issue), the case materials (two cases), and order² (two orders). In groups of 5-10, participants read a brief transcript of either a murder or hit-and-run trial. Included were a case summary and the testimony of four witnesses regarding four separate items of evidence. Three witnesses were in agreement while the fourth provided inconsistent testimony.

Afterwards, participants were asked to render a verdict and to rate the probability that the defendant was guilty. Half of the participants were asked to recall as much as the evidence as possible and to write it down in the order they remembered it. Recall of participants who heard the evidence in story order showed more story organization while the recall of those who heard evidence in issue order showed more issue organization.

² According to Pennington and Hastie (1992), this order variable for story organization balanced a slight primacy advantage for inconsistent credibility information in the first order condition with a comparable primacy disadvantage in the second order condition.

There was a stronger tendency for participants receiving evidence in story order to give verdicts in the direction of the preponderance of evidence, to be more confident in their decisions, and to be more influenced by witness credibility. The results support the idea that story structure and not memory for the evidence is what impacts upon jurors' verdict decisions and overall witness credibility (Pennington & Hastie, 1992).

Voss and Van Dyke (2001) examined whether an interaction exists between level of coherence-chronology and strength of evidence of criminal trial testimony.

Participants included 64 undergraduate psychology students, half of whom were women and half men. Each participant served in four conditions as determined by crossing evidence (strong, weak) with narrative structure (high coherent-chronology, low coherent-chronology). Different narratives describing events of a murder were constructed for each of the four conditions, but all baseline stories were written so that there was substantial but inconclusive evidence against the defendant. In the weak evidence condition, the baseline stories were changed to give alternative explanations of events that would shed doubt on the defendant's guilt. To create the low-coherence-chronology stories, sentences from the baseline narrative were randomized as per a procedure used by Voss, Wiley, and Sandak (1999).

In groups of eight, participants were given a packet with the four different prosecutor's statements corresponding to each of the experimental conditions. They read each narrative and were then asked to rate on a scale from 1 to 11 whether the defendant was guilty. Participants were asked to judge the convincingness of the prosecutor's argument, the quality of the argument, and the strength of the evidence. Across

conditions, results indicated that when the evidence was weak, judgments of guilt were relatively low regardless of the quality of the narrative. Conversely, when the evidence was strong and the narrative was highly coherent, ratings of guilt tended to be higher, though not significantly so. It appears, therefore, that quality of the evidence may be more important to jurors than the quality of the narrative itself in determining decisions of guilt or innocence (Voss & Van Dyke, 2001).

In a second experiment consisting of two parts (a and b), Voss and Van Dyke (2001) assessed the extent to which ratings of guilt were influenced by relative certainty of the contents of crime-related or non-crime related statements. They also examined the role of participant gender and the extent to which emotional statements regarding the defendant, crime, or victim influenced judgments of guilt. The same procedure and four baseline stories from Experiment 1 were used but were manipulated in terms of certainty of information and emotional content. In Experiment 2a, 96 university undergraduates read the four narratives and were asked to provide ratings of guilt, convincingness, and quality of evidence. When evidence was relatively uncertain, participants gave marginally lower guilt ratings, however, emotional content of the crime and gender did not have a significant effect on ratings of guilt. A three-way interaction between story, gender, and emotion was found, and post hoc analyses revealed that women responded to emotional statements related to the defendant while men responded to emotional statements regarding the crime and evidence. Furthermore, the prosecutor's statement was rated as less convincing and of lower quality in the crime-related uncertain condition.

In Experiment 2b, Voss and Van Dyke (2001) followed the same procedures as in Experiment 2a, however, in the certainty manipulation, none of the uncertainty items that were added were related to the crime (non-crime related statements). Participants were 96 undergraduate students who had not already taken part in the two previous experiments. Results indicated that uncertain crime-irrelevant information produced lower guilt ratings compared to the baseline story. Similarly, lower ratings of guilt were found in the emotion conditions than in the baseline conditions. However, compared to the crime-irrelevant uncertain information, baseline stories were rated as more convincing and of better quality. Overall, the three experiments conducted by Voss and Van Dyke (2001) lend support to Pennington and Hastie's (1986) Story Model. Jurors clearly respond to evidence that is presented in story form, however, when uncertain statements or emotional expressions are present, they appear to influence jurors' ultimate verdicts as well as credibility ratings of the prosecutor. Perhaps most importantly, the coherence of the evidence story and the strength of the evidence appear to have a significant impact on jurors' ratings of guilt or innocence.

In sum, what began as a theory that jurors impose story structures on evidence presented in trials and that they use related world knowledge and expectations to form these stories and their subsequent verdicts (Pennington & Hastie, 1986) has since become a validated and well-established working model of jury decision-making. When discussing evidence from a trial, jurors spontaneously exhibit story features with causal events and episode structures consisting of initiating events, psychological and physical states, goals, actions, and consequences (Pennington & Hastie, 1986). Moreover, the

stories they construct are directly related to their ultimate verdict choices (Pennington & Hastie, 1988). Stories that are easiest to construct, and hence, the most coherent, are particularly influential in jury decisions, and the quality, certainty, and emotionality of the evidence are key features that impact verdicts as well as the perceived credibility of the prosecution (Pennington & Hastie, 1988; Voss & Van Dyke, 2001).

As previously mentioned, one of the central features of the Story Model is that jurors use their own world knowledge, beliefs, and biases to infer missing information or fill in gaps that exist in the testimony (Pennington & Hastie, 1986). However, less is known about just how these beliefs and biases impact jurors' ultimate decisions of guilt, particularly in trials involving DNA evidence. In fact, considering that DNA evidence has been used with increased frequency in court cases over the past two decades (Golding, Stewart, Yozwiak, Djadali, & Sanchez, 2000), research examining the impact of DNA evidence on jury decision making is relatively limited in scope.

The Impact of DNA Evidence on Jurors

DNA profiling was first used in the criminal justice context in the mid-1980s in two rape murders that occurred in the United Kingdom (Briody, 2004). At that time, it was demonstrated that DNA had better discriminatory power than the previous serological methods of blood type analysis that had been used in the past. As a result, the use of DNA as a tool in criminal investigations has gained worldwide acceptance. One of the benefits of DNA is that it is relatively stable over time, therefore, samples collected many years ago can be compared to more recent samples (Briody, 2004). Furthermore, DNA is resistant to many conditions that would destroy other biological materials.

The four bases that occur in DNA are adenine, guanine, cytosine, and thymine and the various combinations of these bases are unique to each individual with the exception of identical twins (Aitken & Taroni, 2004). The regions of the DNA molecule that are variable between individuals are the ones that are exploited for forensic purposes by comparing the DNA profile from an unknown evidence sample to either the DNA profile of a known individual, or to DNA from other evidence samples (Briody, 2004). In the criminal justice context, DNA that is analyzed and profiled for identification purposes is gathered from residual material from crime scenes, from victims or suspects, or from objects (Kobilinsky, Liotti, & Oeser-Sweat, 2005). Cells containing DNA can be found in blood, tissue, bone, hair roots, saliva, and skin, and only very small amounts of DNA are needed for an analysis to occur (Briody, 2004). More specifically, cells from saliva can be found on cigarette butts, drink containers, and toothbrushes while skin cells can be obtained from hats, weapons, clothing, and car steering wheels (Briody, 2004).

The majority of research surrounding DNA appears to be conducted in the life sciences as opposed to the social sciences as evidenced by a recent Psych Info³ search using the keyword “DNA”. The search resulted in over 2000 hits of which only approximately 20 hits referred to sources examining DNA in a criminological context. The majority of the remaining references involved examinations of the relationship between DNA and various physiological diseases and/or neurological malfunctions in humans and animals. Of the limited existing research that examines how jurors are impacted by DNA evidence, the majority focuses on jurors’ statistical reasoning

³ Psych Info is a database that references research articles, books, and dissertations from around the world.

capabilities (i.e., Aitken & Taroni, 2004; Koehler, 2001; Koehler & Macchi, 2004). This research consistently finds that laypeople do not always understand or properly interpret DNA statistics and that they have difficulty assessing the probative value of a DNA match clearly and consistently (Koehler, 2001). However, it has also been found that a defendant's claim that an incriminating DNA match is merely coincidental holds more weight with jurors under certain circumstances. Specifically, when it is easy for jurors to imagine (i.e., through statistical examples given in court) other individuals whose DNA could also match, they may be more likely to think that the incriminating DNA evidence is a coincidence (Koehler & Macchi, 2004). Therefore, the method in which statistical DNA evidence is presented to jurors determines how persuasive this evidence will be.

One area of research that has garnered some attention in the criminal justice context involves the use of DNA testing in exonerating the wrongfully accused and convicted. For example, Perske (2005) described a list of 38 individuals with intellectual disabilities who confessed to serious crimes such as murder, rape, arson, and robbery and who were later found to be innocent of the crimes they confessed to. Of the 38 cases, half were exonerated by DNA testing. Similarly, other research has described high-profile cases in which defendants were prosecuted, convicted, and sentenced on the basis of mistaken eyewitness identification or false confessions and then later exonerated through DNA evidence (i.e., Connors, Lundregan, Miller, & McEwan, 1996; Huff, 2004; Kassin & Gudjonsson, 2004). Moreover, DNA testing also has pre-trial implications. For example, Scheck, Neufeld, and Dwyer (2000) reported that in 18,000 criminal cases, over 25% of prime suspects were excluded before the trial because of the results of DNA

testing. Moreover, the true number of wrongful accusations and convictions is unknown given that many criminal cases do not have DNA samples available for testing (Huff, 2004).

It has been found that incriminating DNA evidence is a powerful influence on a juror's decision to convict a defendant. Specifically, Briody (2004) examined a sample of 150 solved and completed cases referred by police for prosecution in Queensland, Australia. In half of the cases, prosecutors produced DNA evidence that tied the accused to the crime while the other half served as a control group that did not include DNA evidence. Cases with DNA evidence were more likely to reach court than cases without such evidence, and when the prosecution used DNA evidence, juries were more likely to convict the defendant than when DNA evidence was not used (Briody, 2004).

One empirical study examined the impact of DNA evidence on jurors in a child sexual assault trial (i.e., Golding et al., 2000). The DNA evidence was given in comparison to the testimony of an alleged 6-year old child victim of sexual assault. It was found that mock jurors rendered more guilty verdicts and that they tended to believe the victim more when there was DNA evidence (either presented alone or corroborating the victim's testimony) indicating that the defendant was guilty. However, the impact of the DNA evidence was attenuated when an alibi witness testified as to the defendant's whereabouts at the time of the assault. DNA evidence, therefore, has a powerful influence on jurors, however, this power is not absolute. Other factors, such as the strength of the evidence (Briggs & Krantz; Devine et al., 2001) may also be important and should be studied.

When jurors hear evidence during a trial, they may perceive individual evidence items as being either strong or weak for many different reasons (Devine et al., 2001). If the evidence is strong, jurors may be more easily able to construct stories that are coherent and complete without needing to rely on personal biases and beliefs. However, if the evidence is weak or ambiguous, it may be that jurors' stories will have more gaps and inconsistencies, and in turn, jurors will rely more heavily on their beliefs in order to make the story more complete. In either case, verdict choices will be dependant on the jurors' stories, however, when evidence is strong, the verdict may be led primarily by the evidence, whereas when evidence is weak or ambiguous, the verdict may be more a function of jurors' beliefs. Studies that address strength of evidence are reviewed next.

Strength of Evidence and Juror Beliefs

Jurors' prior beliefs about various aspects of a trial (i.e., evidence, crime categories, etc.) influence their decisions (Hart, Evans, Wissler, Feehan, & Saks, 1997; Smith, 1991, 1993). However, it is important not only to understand what kinds of beliefs and attitudes can influence jurors' decisions, but also under what conditions they have their greatest influence (Giner-Sorolla, Chaiken, & Lutz, 2002). For example, jurors with authoritarian personalities are more likely to convict a defendant and apply the death penalty when this is an option in a criminal case (Narby, Cutler, & Moran, 1993). Similarly, attitudes and beliefs regarding ethnicity can impact upon jurors' decisions in racially charged cases (Dovidio, Smith, Donnella, & Gaertner, 1997).

It appears, however, that jurors' attitudes and beliefs are particularly influential when the evidence presented in a case is weak or ambiguous as opposed to strong (Jones,

1997; Pfeifer & Ogloff, 1991). This fits with the Story Model of jury decision-making (Pennington & Hastie, 1986) since missing or incoherent evidence is filled in by jurors according to their attitudes, beliefs, and expectations. Strength of evidence (SOE)⁴ is a term used in jury research that refers to the quantity and quality of evidence presented by the plaintiff/prosecution during a trial (Devine et al., 2001). In a recent review by Devine et al. (2001), SOE was reported as showing a strong positive association with jury verdicts. Specifically, conviction rate differences as a function of weak versus strong SOE levels ranged from 24% to 70%.

De La Fuente, De La Fuente, & Garcia (2003) studied the relation between pretrial juror biases and mock jurors' verdicts by manipulating SOE. Participants were 153 undergraduates (*M* age = 23.03 years) attending a Spanish university who were chosen from a wider sample in a previous phase of the study. On the basis of participants' scores on the Spanish adaptation of the Juror Bias Scale (JBS; De La Fuente, 2001, see discussion in De La Fuente, et al., 2003), two groups were formed: one biased towards the prosecution (P-biased) and the other biased towards the defense (D-biased). The JBS, both in its original form (Kassin & Wrightsman, 1983) and its Spanish adaptation (De La Fuente, 2001, see discussion in De La Fuente et al., 2003) is designed to determine the tendency of jurors to convict or acquit individuals implicated in criminal cases across two dimensions: the probability of guilt and the individual criterion of reasonable doubt. Within both the D-biased and P-biased groups, participants were

⁴ A list of acronyms used frequently in this paper is included in Appendix Q.

randomly assigned to juries in groups of nine for a total of nine homogeneous P-biased juries and eight homogeneous D-biased juries.

Each jury viewed two video recordings of a real-life homicide trial. One trial was selected because the evidence against the defendant was very strong and the other trial was selected because the evidence against the defendant was ambiguous. After watching the first video, participants were required to answer some questions individually that pertained to verdict choice, confidence in the verdict, and perceived ambiguity of the evidence. Juries were then informed of the decision rule and the voting procedure and were asked to deliberate until they arrived at a definitive verdict. Once a verdict was reached, jurors once again individually answered the same questions they had been asked prior to deliberation. After a 15-minute break, juries watched the second video of a homicide trial and followed the exact same procedure as outlined above.

Results revealed a significant interaction between bias tendency and SOE. Specifically, when the evidence was ambiguous, P-biased jurors showed higher proportions of guilty verdicts than D-biased jurors both pre and post deliberation. However, when the evidence was strong, there was no difference between the groups with respect to verdict. Furthermore, in the ambiguous evidence trial, both the P-biased and D-biased jurors reached a significantly smaller number of guilty verdicts than in the strong evidence trial. Jurors also rated having more confidence in their verdicts when the evidence was strong than when it was ambiguous regardless of bias tendency. Overall, it appears as though jurors' preconceived biases influence their verdicts and confidence ratings only when evidence presented in a trial is ambiguous. One critique of this study

is that it did not include a weak evidence condition. This would be an important condition to include because it is unclear whether jurors' verdicts based on their beliefs would be different with weak versus ambiguous evidence. In real life cases, jurors are exposed to ambiguities such as contradictory evidence, therefore, it is important to understand how their decision-making differs in these cases compared to when the evidence is either weak or strong. Based on De La Fuente et al's (2003) results, it might be expected that less guilty verdicts would be rendered when evidence is weak compared to ambiguous. It would also be expected that the highest number of guilt ratings would be rendered in the strong evidence condition compared to either weak or ambiguous evidence.

Researchers have proposed that when evaluating the validity of DNA and other types of statistical evidence, jurors may be particularly influenced by their background beliefs and expectancies given the ambiguous nature of probability estimates (e.g., Balding, 2000; Schklar & Diamond, 1999; Thompson & Schumann, 1987). Specifically, jurors may be unclear as to how to interpret the information regarding probability estimates that is usually presented along with DNA evidence in court, thus making the evidence appear to them to be ambiguous or possibly weak. This particularly becomes a problem when jurors are called upon to combine probability estimates. For example, if an expert witness testifies that the lab error rate (LE) associated with a DNA match report (i.e., a report of a match between the defendant's or victim's DNA profile and DNA evidence found at the crime scene) is 1 in a billion and that the chance of a random DNA match (RMP) is 2 in 100, the larger estimate, in this case for RMP, dwarfs the smaller LE

estimate (Schklar & Diamond, 1999). That is, the combined estimate of either a LE or RMP becomes 2 in 100. More specifically, the LE is the probability that a match report was declared due to a human error that occurred in the DNA lab, while the RMP is the probability of a match being declared due to random chance (Schklar & Diamond, 1999).

In order to examine the extent to which jurors' reactions to DNA evidence are guided by their expectancies and by error rates, Schklar and Diamond (1999) studied 219 jury-eligible undergraduate psychology students (*M* age = 19.5 years). In groups of 7-15, participants read a two-page crime scenario vignette describing a defendant on trial for sexual assault. It was indicated that the female victim did not know the male defendant and could not identify him in a lineup because he had been wearing a mask. The defendant became a suspect in the sexual assault because on the same night as the attack and in the same area where it occurred, he was stopped by police for making an illegal U-turn and an illegal knife was subsequently found in his car. Participants were then randomly assigned to read one of seven versions of an expert witness testifying that DNA extracted from semen stains on the victim matched the defendant's DNA.

The seven versions of the expert testimony crossed information about the source of the DNA match report (i.e., RMP or LE) with information about the size of the probability estimates (i.e., 1 in a billion, 2 in 100, or not given) in different combinations. Participants were divided across four conditions: single-estimate (SE), two-separate-estimates (TSE), two-separate-estimates plus combination-instructions (TSECI), or single-combined-estimate (SCE). Half of the SE participants learned that the RMP was 1 in a billion and half learned that the LE was 1 in a billion with neither half being given

information about the opposite source. Similarly, half of the TSE participants learned that the RMP was 1 in a billion and that the LE was 2 in 100 while the other half learned that the RMP was 2 in 100 and the LE was 1 in a billion. The TSECI condition was the same as TSE except that participants were also told by a criminalist how to mathematically combine RMP and LE estimates so that they end up with a combined estimate of about 2 in 100. Finally, SCE participants were only told that the probability of either a RMP or a LE was 2 in 100 without being given separate RMP and LE estimates. All participants were asked to decide whether the defendant was guilty. They were asked questions testing their memories about the probabilities that had been presented to them (where applicable) as well as what they really thought about these probabilities. Participants who did not receive information about RMP or LE rates were asked to estimate how probable they thought these events would be (Schklar & Diamond, 1999).

Results indicated that participants rendered guilty verdicts (78%, 88%, and 84% in the SE, TSE, and TSECI conditions, respectively) more often when provided with extremely small probability estimates than when given a larger combined probability estimate (61% in the SCE condition). Participants in the TSE group rendered more guilty verdicts than those in the SE group (88% vs. 78% respectively), however, participants in the TSECI condition (84%) gave guilty verdicts as often as those in the TSE and SE groups. Extremely small RMP estimates with larger LE estimates resulted in less guilty verdicts than extremely small LE estimates with larger RMP estimates (81% vs. 91% respectively). Furthermore, participants gave guilty verdicts more often when they

received extremely small LE estimates and no RMP information (90%) compared to extremely small RMP estimates and no LE information (66%). Interestingly, participants averaged an uninformed estimate of 1 in 15 for LE which is about 3 times larger than the estimate of 2 in 100 provided by the expert criminalist and about 22 times larger than the participants' average uninformed RMP estimate that was approximately 1 in 333. Thus, mock jurors have very different beliefs and expectations about LE rates compared to RMP rates that serve to guide their verdict choices and they may not be clear on how to combine probability estimates even when given instructions on how to do so (Schklar & Diamond, 1999).

The results of this study indicate that evaluations of DNA evidence by jurors are influenced not only by systematic errors, but also by their personal beliefs and expectations however accurate (or inaccurate) these may be. As indicated by Schklar and Diamond (1999), jurors are likely to have different beliefs about the credibility of the experts who provide probability estimates, the criminalists responsible for conducting the laboratory tests, as well as the trustworthiness of the professionals who collect the laboratory samples. They may have other explanations as to why an erroneous DNA match can occur besides RMP or LE. Probability estimates certainly can guide jurors in making decisions concerning DNA evidence, however, these estimates are not always properly understood or properly combined by jurors when they should be. Personal beliefs and expectations may therefore be much more influential in determining verdicts given the perceived ambiguity of probability estimates.

In sum, the research on SOE reveals that jurors tend to rely on their beliefs in rendering verdicts only when the evidence in a case is perceived to be weak or ambiguous. When the evidence is strong, jurors appear to be able to put aside their beliefs and let the evidence guide their verdict choices. Furthermore, evaluations of DNA evidence are influenced by both systematic errors (i.e., lab error rates and random match probabilities) and by jurors' personal beliefs (Schklar & Diamond, 1999). Another issue to consider is that of whether beliefs come into play differentially when trial evidence is ambiguous (i.e., when there is conflicting information available to jurors) versus weak. This is an important issue considering that in real life cases, jurors almost always hear conflicting information during a trial. Based on the Story Model (Pennington & Hastie, 1988), it would be predicted that jurors would tend to fall back on their beliefs when faced with ambiguous evidence since the ambiguity could be interpreted as a lack of coherency and consistency. However, it is unclear whether there is a difference between ambiguous evidence and weak evidence with respect to the role of jurors' beliefs on verdict decisions. Based on De La Fuente et al's (2003) research, it can be speculated that jurors would give fewer guilty verdicts when evidence is weak than when it is ambiguous, given that ambiguous evidence would fall somewhere in the middle on the continuum between strong and weak evidence.

Another issue brought to light by Schklar and Diamond's (1999) study is that of the statistical presentation of DNA evidence. Given that jurors do not always understand probability estimates or combination rules provided by expert witnesses, they may view this evidence as confusing (Taroni & Aitken, 1997) or weak and therefore tend to rely on

their beliefs and expectations in reaching their verdicts. Research on the effects of statistical presentation on decision making is discussed next.

Statistical Presentation of DNA Evidence

It has been found that when jurors receive separate LE and RMP estimates, they do not effectively combine the estimates, even when instructed on how to do so, and instead are more influenced by the smaller estimates which, when combined ultimately become irrelevant in light of the larger estimates (Koehler, Chia, & Lindsay, 1995). This may not entirely be related to how weak or strong the DNA evidence is, but rather it may be a reflection of the confusion some jurors experience when dealing with statistical or probability-based information. According to Thompson, Taroni, and Aitken (2003), even when jurors understand the various ways in which a false positive DNA match can occur, this does not mean that they can accurately determine what the probability of such an error is in a given case based on common sense. It can be difficult for jurors to understand how complex scientific evidence is generated and to evaluate the convincingness of the results, therefore, statistical reasoning can assist forensic scientists and jurors in reaching more correct conclusions (Taroni & Aitken, 1997).

Research that has examined different types of human reasoning under uncertainty indicates that frequency formats (i.e., “1 in 1000”) as opposed to probability formats (i.e., “0.1%”) correspond better to the sequential way information is naturally acquired (Gigerenzer & Hoffrage, 1995). According to Gigerenzer and Hoffrage (1995), mathematically equivalent representations of information require the use of different cognitive algorithms that are not necessarily computationally equivalent. The term

“natural frequencies” has been used to describe the notion that as humans evolved, they acquired new information in the form of frequencies as actually experienced in a series of events, rather than as probabilities or percentages (Cosmides & Tooby, 1996; Hoffrage & Gigerenzer, 1998). Therefore, information that is represented as frequencies should be computationally easier to understand because it conforms to humans’ natural cognitive algorithms (Sedlmeier & Gigerenzer, 2001). Some may argue that presenting information as a probability should not be much different than presenting it as a frequency since a percent is simply a frequency out of a population of 100, however, Cosmides and Tooby (1996) argue that raw frequency information is more informative than percent information because it contains information about sample size. Since percents are normalized on a population of 100, they contain no information about the sample size the number was originally drawn from, and therefore no information about how reliable that number is. When information is presented in some other format, people must be taught how to translate or re-represent that information in a way that is tuned to their cognitive algorithms (Sedlmeier & Gigerenzer, 2001).

Hoffrage and Gigerenzer (1998) tested whether physicians’ diagnostic inferences could be improved when information was presented using frequencies rather than probabilities. Participants were 48 physicians who were asked to determine the positive predictive values (PPVs) of four diagnostic tests for breast cancer, colorectal cancer, phenylketonuria, and ankylosing spondylitis. The participants received two of the problems with information as probabilities and the other two with information as natural frequencies. Results showed that when the information was presented as probabilities,

physicians estimated the PPVs correctly in only 10% of the cases. However, when the information was presented as frequencies, the correct PPV estimation percentage increased to 46%. Communication of information both within medical textbooks and between physicians and their patients would therefore be improved if it was presented in a frequency format rather than as probabilities or percentages.

Across eight experiments, Cosmides and Tooby (1996) found that inductive reasoning performance differed depending on whether participants were asked to judge the frequency or the probability of a single event. Participants' performance on frequency versions of problems was superior to non-frequency versions. Specifically, participants who were given probability or other non-frequency versions of a medical diagnosis problem arrived at the correct answer 12% of the time, while those who received frequency versions of the same problem arrived at the correct answer 76% of the time. When participants were asked to construct a concrete visual frequency representation (i.e., a pictorial representation of the information by filling in squares or circling an item), they arrived at a correct answer 92% of the time. These results support the notion that frequency representations work well because they appear to cause certain cognitive biases that are inherent in other forms of statistical representations to disappear. For example, participants exposed to frequency representations commit the conjunction fallacy (i.e., assuming that specific conditions are more probable than general ones) less often than those exposed to probabilities (Cosmides & Tooby, 1996). Similarly, Cosmides and Tooby (1996) define the overconfidence bias as, "the discrepancy between one's degree of belief in a single event and the relative frequency with which events of

that class occur” (p. 19) and this bias occurs less often when frequencies as opposed to probabilities are presented. Finally, because of the way frequency information is presented, base rate neglect is not an issue as it often is with other forms of statistical presentation (Cosmides & Tooby, 1996).

According to Koehler (1996), DNA statistics presented in court as likelihood ratios are problematic. He states that even if scientists could uniformly agree on the proper form and approximate values of DNA likelihood ratios, it is unclear as to whether jurors would understand what they mean. Koehler (1996) states that jurors and even scientific experts themselves often confuse likelihood ratios with posterior odds ratios where the former describes the value of evidence in light of competing hypotheses and the latter describes the probability of competing hypotheses in light of the evidence.⁵ Given that likelihood ratios are ratios of conditional probabilities (Koehler, 1996) and that past research has shown that people have trouble reasoning with probabilities, but are instead better able to reason with frequencies (i.e., Cosmides & Tooby, 1996; Gigerenzer & Hoffrage, 1995), Koehler (1996) suggested that jurors would have more trouble understanding likelihood ratios compared to frequencies.

Using 256 jury-eligible participants from an American university, Koehler (1996) conducted a study to test the impact of likelihood ratios versus frequency statistics in DNA cases. Participants were provided with a written summary of a rape case in which the suspect was identified when the victim chose his picture from a set of police pictures.

⁵ Taken from Koehler (1996), an example of DNA evidence presented as a likelihood ratio would be, “It is 270 million times more likely that we would see this evidence if Mr. Simpson were the source of the blood than if Mr. Simpson were not the source.” Stated as a posterior odds ratio, the statement would read, “Given this evidence, it is 270 million times more likely that Mr. Simpson is the source of the blood than that Mr. Simpson is not the source.”

In court, the victim testified that she was “pretty sure”, but not positive, that the defendant was her attacker. The summary also included evidence of a DNA match between the defendant and semen found from a rape kit examination of the victim. The DNA match was presented to participants in one of three statistical forms: a frequency, a likelihood ratio, or a posterior odds ratio. When presented as frequencies, participants viewed the DNA profile as being either 1 in 100 or 1 in 1000. When presented as likelihood or posterior odds ratios, participants viewed the DNA profile as being either 100:1 or 1000:1, respectively. After reading the case summaries, participants estimated the probability that the defendant was the source of the sample and rendered a verdict of guilty or not guilty.

Results showed that there were no main effects or interactions involving the numerical size of the profile frequency (i.e., 100 vs. 1000) or gender, therefore the data were collapsed across these two variables. Overall, participants who were presented with frequencies assigned lower probabilities to the proposition that the suspect was the source of the DNA than did participants who were presented with likelihood ratios or posterior odds ratios (65% vs. 75% vs. 80%, respectively). Post hoc testing further revealed that only the differences between the frequency and likelihood ratio conditions and between the frequency and posterior odds ratio conditions were significant. Furthermore, participants who were presented with frequencies were less likely to render a guilty verdict than participants who were presented with likelihood ratios or posterior odds ratios (21% vs. 35% vs. 41%, respectively). The results of post hoc analyses once again revealed that the only significant differences were between the frequency and likelihood

ratio conditions and the frequency and posterior odds ratio conditions. Overall, the results suggest that people more easily interpret and understand frequencies over likelihood ratios, but that likelihood ratios and posterior odds ratios are interpreted similarly. Koehler (1996) concludes that this is problematic because posterior odds ratios speak directly to the issue of the probability that the defendant is the source of the DNA, however, testing of DNA evidence itself cannot directly answer the source probability question. Testing of DNA evidence can only report whether there is a match between the defendant's genetic profile and the genetic profile of the DNA found at the crime scene.

In sum, jurors appear to have difficulty understanding complex scientific evidence and how to interpret this evidence when it is statistically presented (Taroni & Aitken, 1997). For example, the frequency of a RMP tends to be overweighed by jurors and when it is presented along with a LE estimate, the LE estimate has an extremely weak impact on the interpretation of the evidence compared to the RMP estimate (Taroni & Aitken, 1997). Furthermore, research examining human reasoning under uncertainty, both in a legal and a general context, indicates that frequency formats appear to be more easily understood than probabilities or likelihood ratios (Cosmides & Tooby, 1996; Gigerenzer & Hoffrage, 1995; Koehler, 1996). Given that DNA evidence is presented to jurors in a variety of statistical formats in the courtroom, it is important that jurors be educated as to the meaning of these various statistics so that they do not make judgments based on their own beliefs (some of which may be erroneous) about what the numbers mean. Therefore, expert testimony must strive to present statistical DNA information in such a way that it is clear and less confusing for jurors. Otherwise, jurors' reactions to

DNA evidence presented in the courtroom might be more a function of their own beliefs than of rational and realistic baseline error rates associated with DNA.

The Impact of Expert Testimony on Jury Decision Making

Schuller (1990) began to study the impact of expert testimony regarding battered woman syndrome (BWS) on jury decision making following a landmark case in the Supreme Court of Canada in 1990 (*Lavallee v. R.*). In this case, the issue of the admissibility of this type of expert testimony was addressed and the court ruled in favour of its admission. The aim of expert testimony on BWS is to provide jurors with a conceptual framework for evaluating the battered woman's perceptions and actions surrounding the homicide (Schuller & Yarmey, 2001). Schuller (1990) therefore reviewed the assumptions leading to the Court's ruling as well as the relevant social science research that investigates the impact of expert testimony on jury decision-making. Expert testimony is needed in cases involving BWS because the woman's account of the events surrounding the killing are difficult for jurors to understand as being reflective of self-defense (Schuller, 1990). This is due to the fact that neither her actions nor jurors' beliefs about how a woman would respond to this type of situation fit the traditional notion of self-defense. However, when expert testimony is available, jurors seem to better comprehend why a woman may have perceived herself to be in danger at the time of the killing.

In order to test the impact of BWS testimony on jury decision making in trials of battered women who kill their abusers, Schuller (1992, Experiment 1) recruited 108 undergraduate students to participate in a mock jury study. Participants were assigned to

one of three expert witness conditions (control, general expert, specific expert) and they read a 50-page transcript of a criminal trial that was loosely modeled after a real case involving a battered woman who killed her husband and was subsequently charged with second degree murder. In both the general and specific expert conditions, participants received information explaining the social science research regarding battered women, the cyclical nature of battering behaviour, feelings of fear, anxiety, and learned helplessness experienced by battered women, and myths about the causes of wife abuse. Participants in the specific expert group further read a statement by the expert that was based on a clinical assessment of the woman, who displayed the behavioural and emotional characteristics of a woman suffering from BWS. After reading the transcripts, participants rendered a verdict of either second degree murder, manslaughter, or not guilty. They also listed the pieces of evidence that most influenced their verdict and gave ratings (on a 7-point scale) of how competent, effective, and convincing the attorneys were. Alternative interpretations of the defendant's beliefs and behaviours were rated on a 9-point scale by the participants. Finally, participants rated the believability of the expert, the extent to which BWS applied to the defendant, and the extent to which support existed for BWS.

Results showed that female participants were more lenient in their verdict decisions than males. In the no expert (control) and general expert conditions, verdict decisions were evenly distributed across the three verdict alternatives, however, in the specific expert condition, there were more manslaughter and not guilty verdicts compared to murder verdicts. Female jurors, compared to males, were also more likely to perceive

that the defendant feared for her life and was in danger, that she used necessary force, and that she was trapped in her relationship and unable to leave. Jurors in the specific expert condition were more likely than those in the general expert condition to believe that the defendant's life was in danger, that the killing was not intended, and that she was telling the truth. Those in the specific condition (compared to the general condition) also rated the prosecutor as less persuasive and the defense attorney as more persuasive and they reported that BWS applied more to the defendant. In sum, the specific expert testimony was more successful than general expert testimony or no expert testimony in influencing jurors' interpretations of the defendant's behaviour, which in turn influenced verdict choices (Schuller, 1992).

Schuller, Smith, and Olson (1994) focused on four factors that can influence jurors' decisions in BWS: prior beliefs about abuse, the presence of expert testimony, beliefs in a just world, and gender. Participants were 88 students who had scored below the median on "belief in a just world" scores from a previous mass testing session and 88 participants who had scored above the median. Since 12 participants could not be contacted, the final sample size was 164. Besides the belief in a just world questionnaire, participants answered 21 questions (rated on 6-point scales from *strongly agree* to *strongly disagree*) assessing their beliefs about abuse. The questions tapped into various dimensions of wife abuse including so-called "justifications" for the violence, psychological reactions of battered women, and the factors contributing to a woman's entrapment in the relationship. A single composite measure of beliefs about abuse was calculated by performing a principal components analysis on the 21 items. Items with

factor loadings greater than $\pm .40$ were retained for the scale, resulting in an 11-item measure. High scores on the measure were indicative of beliefs that were less informed, and hence, more negative, about the battering context. Participants heard a 30-minute audiotaped summary (either with expert testimony or without it) of a homicide trial involving a battered woman who had killed her husband and was claiming self-defense. Dependent variables were verdict (first-degree murder, second-degree murder, voluntary manslaughter, or not guilty), juror judgments of the defendant, evaluations of expert testimony (i.e., persuasiveness, believability, usefulness), and postbeliefs about abuse.

Generally, it was found that participants exposed to the expert and those who were more informed about abuse were more likely to find the defendant's claims more believable (Schuller et al., 1994). Jurors' preexisting beliefs about abuse influenced evaluations of the battered woman's self-defense claim, with those less informed about the dynamics of abuse being less likely to believe the battered woman's claim. Jurors who were exposed to expert testimony and who were more informed about abuse were more likely to indicate that BWS applied to the defendant and that there was support for the syndrome. Weak believers in a just world were more lenient in their judgments and tended to give more not guilty verdicts, and they were more likely to be influenced by expert testimony than strong believers. Female weak believers in a just world were less likely to attribute responsibility to the defendant when they were presented with expert testimony and they were also more open to information provided by the expert compared to female strong believers.

Postbeliefs about abuse were examined by having the participants complete the same 11-item beliefs about abuse measure that they completed before being exposed to the trial. This was done in order to assess whether jurors' beliefs about abuse were altered by the testimony they heard during the experiment. It was found that women who were weak believers in a just world were more influenced by the information they heard about abuse compared to strong believers in a just world. However, this difference was not found among the male participants. Overall, the results highlight the interrelation between preexisting beliefs and expert testimony. Jurors clearly come to the courtroom with existing beliefs that guide their perception of the evidence and influence their reactions to legal procedures.

In order to determine whether variations in the psychological focus of expert testimony might lead to differential jury decision processes in a BWS trial, Schuller and Hastings (1996) examined whether portrayal of a woman's behaviour towards her batterer, in particular her degree of passivity, would influence jury decisions. Participants were 195 undergraduates and 202 jury-eligible volunteers from the community. They read a 23-page transcript involving a battered woman based on a real case. Participants were randomly assigned to a 2 (responsiveness: passive, active) by 3 (expert testimony: no expert vs. battered woman syndrome testimony (BWS) vs., social/agency testimony (SA))⁶ design. Dependent variables included verdict (second degree murder vs. manslaughter vs. not guilty-self defense), perceptions of the

⁶ In the BWS condition, the expert explained that battered women experience a set of emotional and psychological reactions referred to as "battered woman syndrome" which is a subcategory of post-traumatic stress disorder. The expert also explained the concept of learned helplessness. The expert in the SA condition did not mention the term BWS or the concept of learned helplessness but instead focused on the actions battered women tend to take as well as the obstacles battered women face when seeking help.

defendant's claim, psychological stability of defendant, and evaluations of expert testimony (i.e., persuasiveness). Results indicated that both the sex of the participant and the presence of expert testimony influenced verdicts and judgments regarding the defendant's case. Women were more lenient in their verdict decisions and were more believing of the defendant's claim of self defense. Furthermore, both the student and nonstudent samples rendered more lenient verdicts in the presence of expert testimony. However, the expert testimony had a greater influence on the students compared to the nonstudents. Juror judgments did not differ according to whether the expert testimony was in the BWS or SA form, and they did not differ according to whether the woman's response to violence in her relationship was passive versus active.

Schuller, McKimmie, and Janz (2004) further examined what impact the presence of expert testimony regarding battered woman syndrome would have on a sample of Australian participants within a trial context. Another purpose was to explore whether a social/agency oriented form of expert testimony would alter juror decision processes. Participants were 99 students from an Australian university and 96 students from a Canadian university. They were presented with an audiotaped summary of a criminal trial transcript modeled after an actual case involving a battered woman who had killed her abuser. The participants were randomly assigned to one of three expert testimony conditions: no expert testimony, battered woman syndrome testimony (BWS), or social/agency testimony (SA). Dependent variables included verdict (second degree murder, manslaughter, or not guilty) and confidence in verdict decision, perceptions of defendant's justification for her lethal actions, perceptions of defendant's claim,

psychological instability of the accused, and evaluations of expert testimony. All variables except for verdict were rated on a 9-point scale.

Overall, a similar pattern of results was found for both the Australian and Canadian samples (Schuller, McKimmie et al., 2004). Women were more believing of the woman's claims than were men and the presence of expert testimony had a beneficial impact on the woman's claim of self defense with few differences between the two different types of testimony. Interestingly, when no expert testimony was provided, the Canadian men rendered very few self defense verdicts compared to the other groups, whereas when expert testimony was provided, the Canadian male participants gave more lenient verdict decisions. On the other hand, the presence of expert testimony had a weaker impact on the women and the Australian male participants. The results of the study suggest that the presence of expert testimony is associated with positive outcomes for women in battered women's defense cases.

Schuller, Wells, Rzepa, and Klippenstine (2004) examined the BWS and SA forms of expert testimony regarding battered women while varying the imminence of the husband's threat just prior to the woman's fatal actions. It was predicted that when the killing was committed in the midst of an attack (as opposed to outside of an attack) that jurors would display greater verdict leniency. It was also expected that SA testimony would provide jurors with a more appropriate framework for understanding the defendant's actions than BWS. Participants were 172 undergraduates who read a transcript of a trial (approximately 23 pages) that was modeled after a real case involving a battered woman who had killed her abuser. The design was expert testimony (none vs.

SA vs. BWS) x imminence of abuser's threat (during confrontation vs. after). Dependent variables included verdict (first degree murder vs. second degree murder vs. manslaughter vs. not guilty), perceptions of the case, and evaluations of expert testimony (i.e., persuasiveness, usefulness). It was found that when the defendant's fatal actions were committed outside of a direct confrontation, jurors were less likely to believe the act had been committed out of self-defense and more likely to vote guilty of murder. Women compared to men were more lenient in their verdict decisions and they were also more likely to find the defendant's claim more credible and her actions less under control. When jurors were presented with SA testimony, the imminence manipulation had little impact on verdict judgments, however, when they heard BWS testimony, they were harsher in their verdict decisions if the killing happened outside of a direct confrontation. Therefore, expert evidence regarding battered women appears to be associated with positive outcomes for battered women on trial for killing their abusers. However, SA testimony which focuses more on the battered woman's social context appears to be more beneficial than BWS testimony which focuses on the woman's psychological functioning.

Taken together, these studies clearly indicate that expert testimony assists jurors in understanding the behaviours and circumstances of battered women who kill their partners. Furthermore, when expert testimony is specific to the case at hand rather than generalized to all battered women, jurors are more likely to vote that the defendant is not guilty (Schuller, 1992). Expert testimony also appears to influence jurors' beliefs about abuse from pre to post trial (Schuller et al., 1994). The research on expert testimony

reviewed here deals with BWS cases, however, expert testimony is also used in other cases such as those involving DNA. To date, there is no research that has examined how expert testimony in DNA cases impacts on jurors' decisions.

As previously discussed, jurors enter the courtroom with their own sets of values and beliefs. This includes beliefs about the meaning of statistics both in general and as they pertain to DNA evidence specifically. However, what happens when jurors' beliefs about the meaning of DNA statistics are erroneous or when jurors are confused about the meaning of DNA statistics? Furthermore, what happens when expert testimony specifically addresses statistical issues that may otherwise be confusing for jurors? Based on Schuller's (1992) work, it could be predicted that expert testimony that specifically addresses issues regarding the statistical presentation of DNA evidence (compared to expert testimony that does not) would be more effective. The present study will explore these issues in the context of expert testimony regarding the statistical presentation of DNA evidence.

Purpose of the Present Study and Research Hypotheses

The research reviewed thus far indicates that jurors construct stories about the evidence presented to them in a trial and that these stories directly influence their verdicts (Pennington & Hastie, 1986). When there is missing or incoherent information presented jurors rely upon their own knowledge and beliefs to fill in the gaps. Jurors' beliefs and expectations influence their verdict decisions as suggested by the Story Model (Pennington & Hastie, 1988). Furthermore, in cases with DNA evidence, beliefs appear to interact with other variables such as the strength and complexity of the evidence

(Schklar & Diamond, 1999). Overall, the strength of the trial evidence (Devine et al., 2001) may be especially important in determining whether jurors will rely on their beliefs about evidence in determining a verdict. Furthermore, jurors' beliefs and interpretations regarding the statistical meaning of DNA evidence as it is presented in court may impact upon their decision-making (Hoffrage & Gigerenzer, 1998; Koehler, 1996). Specifically, it has been found that statistical information presented in frequency format seems to be more easily understood than statistical information presented as probabilities or likelihood ratios (Hoffrage & Gigerenzer, 1998; Koehler, 1996). Research involving battered women suggests that jurors who hold strong and inaccurate beliefs about abuse may be less likely to be influenced by expert testimony (i.e., Schuller et al., 1994), and that expert testimony that is specific rather than general (Schuller, 1992) may be more effective. Therefore, it is important to study the influence of expert scientific testimony regarding DNA evidence on jurors' beliefs about DNA evidence.

While research has examined jurors' beliefs about whether defendants are guilty of the crimes they are charged with in a general sense (De La Fuente et al., 2003) to date, there are no published studies that have systematically measured jurors' beliefs and attitudes about DNA evidence and how such beliefs are associated with verdict decisions. Another important and related issue to explore is that of the relation between variations in statistical presentation of DNA and jury decision-making and whether expert scientific testimony can help to clarify statistical confusions that jurors might have. Therefore, the first objective of this research was to examine how mock jurors' beliefs about DNA evidence influence their verdicts in criminal trials. The second objective was to examine

whether statistically equivalent variations in how DNA evidence is presented can impact on jury-decision making. The final objective of this research was to determine whether expert scientific testimony could help to clarify the confusion which may exist around variations in statistical presentation.

Two studies were conducted. The first study examined mock jurors' beliefs towards DNA evidence and how these beliefs impact on their decision making in criminal cases when strength of the evidence is varied. The second study explored the relationship between statistical presentation of DNA evidence and jury decision-making, strength of evidence, and the impact of expert testimony in helping to clarify the meaning of DNA statistics.

Study 1 Predictions

H₁ : When DNA trial evidence is weak, jurors with positive beliefs about DNA will render higher guilt ratings than jurors with more skeptical beliefs. In turn, when the evidence is ambiguous, jurors with positive beliefs will render higher guilt ratings than when the evidence is weak or beliefs are skeptical.

H₂ : When DNA trial evidence is strong, jurors will render the highest guilt ratings regardless of beliefs.

Study 2 Predictions

H₃ : When DNA evidence is strong, jurors who are presented with DNA match error rates in frequency format will render higher guilt ratings than jurors who are presented with the same information in probability or likelihood ratio format.

H₄: When DNA evidence is weak, jurors who are presented with DNA match error rates in frequency format will render lower guilt ratings than jurors who are presented with the same information in probability or likelihood ratio format.

H₅: When expert testimony specifically addresses the issue of statistical presentation (versus when the expert testimony is general in nature), jurors exposed to strong DNA evidence will render similarly high ratings of guilt regardless of how the statistical information is presented.

H₆: When expert testimony specifically addresses the issue of statistical presentation (versus when the expert testimony is general in nature), jurors exposed to weak DNA evidence will render similarly lower ratings of guilt regardless of how the statistical information is presented.

METHOD

Study 1

Participants

During a mass testing session, 1128 first year psychology students at Carleton University completed a questionnaire examining their beliefs about DNA and other types of evidence (see Appendix A). Participants received one experimental credit for completing the mass testing.

From the mass testing, 71 participants (M age = 20.65, SD = 5.16; n = 52 females) were randomly selected from all possible candidates to take part in a mock jury study based on their responses to the DNA items on the questionnaire. Only participants who answered “yes” to the question in the mass testing asking whether they would be interested in participating in a future study about jury decision-making were eligible. Similarly, only participants who answered all of the DNA-based questions in the mass testing were eligible.

Originally, only students who fell above (n = 95) and below (n = 163) one standard deviation from the mean (M = 12.75, SD = 1.53; i.e., those considered to be “strong positive” believers and more “skeptical” believers in DNA, respectively) on the DNA beliefs questionnaire were invited to take part in the mock jury study. However, the response rate by these participants was low, therefore, it was also necessary to invite the participants who fell *within* plus or minus one standard deviation (n = 617; i.e., those considered to have more “neutral” beliefs about DNA) to take part in the study.

Participants had to be eligible for jury duty according to the criteria in Ontario. In Ontario, eligible jurors must be at least 18 years of age in the year preceding the year for which the jury is selected (Granger, 1996). Anyone who has been part of a jury within three years preceding the year for which the jury roll is prepared or who has been summoned as a witness or is likely to be called as a witness in the case at hand is ineligible for jury duty (Granger, 1996). Other exclusionary criteria are listed in Appendix B. Compensation for participation in the mock jury study was in the form of one additional experimental credit (beyond that given for the mass testing), or \$5.00 cash, or entry into a draw for \$50.00 cash. An informed consent sheet was signed by each participant before the beginning of the experiment.

Materials

Beliefs about evidence. In order to gain insight into participants' beliefs about DNA evidence, a questionnaire was developed by the experimenter (see Appendix A). The questionnaire contains 12 items that were chosen in order to tap into participants' beliefs about the accuracy and importance of the various evidence types, as well as how prone the evidence types are to error. Nine questions ask participants about their opinions regarding fingerprint, hearsay, and fiber analysis evidence. These questions are not directly important to the current study but were included so that the true purpose of the questionnaire (i.e., to determine beliefs specifically about DNA evidence) was somewhat less obvious. Three of the questions ask participants about their opinions regarding DNA evidence. All questions are answered on a 1 (*Not at all Important*) to 5

(*Extremely Important*) Likert scale. Wording of the anchor points changed slightly corresponding to the wording of the questions.

Composite scores for DNA evidence were calculated. Specifically, responses to the DNA items were added to form a “DNA beliefs” score⁷. Possible scores for each composite ranged from 3 to 15 with higher scores indicating more positive beliefs about DNA. As can be seen in Table 1, the three items measuring beliefs about DNA were positively and significantly correlated with one another. It should be noted, however, that beliefs about DNA, whether they be highly positive or skeptical, tap into participants’ perceptions rather than the actual accuracy of the DNA evidence in a given case. In order to proceed with the intended analyses, a median split procedure was used to create a categorical DNA beliefs variable. Those scoring at or above the median (Median = 12.00; $n = 44$) were classified as being “strong positive” believers and those scoring below the median ($n = 27$) were classified as being “skeptical” believers. The median split procedure was deemed to be appropriate given that results of an independent samples *t*-test (conducted *after* the median split was done) indicated that the strong positive believers ($M = 13.57$, $SD = 1.19$) scored significantly higher on their DNA beliefs scores than the skeptical believers ($M = 10.41$, $SD = .75$; $t(69) = 13.75$, $p < .001$).

Case summary. Participants read one of three versions (i.e., “Strong DNA”, “Weak DNA”, “Ambiguous DNA”) of a 14-16 page case summary describing the fictitious trial of a male defendant accused of murdering his male friend⁸. The defendant

⁷ Item 9 was reverse scored so that it would be on the same scale as the other two questions

⁸ I would like to thank Dr. Regina Schuller for providing me with copies of transcripts she has used in her mock jury research that I was able to model my own transcripts after.

Table 1

Correlations between items measuring DNA beliefs at pre-test

	1	2	3
1. How accurate is DNA ?	-	.59**	.64**
2. How important is DNA ?	-	-	.55**
3. How often do experts make mistakes about DNA ?	-	-	-

*Note.******* $p < .01$ (2-tailed)

is pleading not guilty to the charge. Each transcript began with the judge's instructions to the jury followed by opening statements from the Crown and the Defense. It was established that the defendant and the victim had been playing cards together at the defendant's house earlier in the evening of the night of the murder. The defendant won the game and wanted to collect on the bet the two had made, but the victim refused to pay. An argument ensued and about a half hour after the two walked away from each other, the victim was found dead on the side of the road. The victim was stabbed and blood samples matching those of the defendant were found on the victim.

Witnesses for the Crown, including the police constable who was present at the crime scene, a friend of the defendant, and a neighbour of the defendant were examined by the Crown and then cross-examined by the Defense. Witnesses for the Defense, including the defendant himself, a friend of the defendant, and a woman who noticed suspicious activity in the neighbourhood the night of the murder were examined and then cross-examined by the Crown. The testimony of a forensic scientist serving as an expert witness for the Crown was also presented. In her testimony, the expert witness establishes that she was asked to examine blood samples from the defendant that were used to conduct a DNA test along with the blood samples found on the victim. The results of the DNA testing found a match between the defendant's blood and that found on the victim. The expert witness was then cross examined by the defense lawyer with respect to the possibility of lab errors and random matches associated with DNA testing. In the "Strong DNA" case (see Appendix C) the expert witness testified that the probability of a DNA match having been found due to a lab error or a random match is

about 1 in one billion⁹. In the “Weak DNA” case (see Appendix D), the expert witness testified that the probability of a DNA match having been found due to a lab error or random match is about 1 in 50 (see Appendix) . In the “Ambiguous DNA” case (see Appendix E), a second expert witness (for the defense) gave conflicting information regarding the probability of a match being due to a lab error or random match.

Besides the probability rates, the only other difference between the case versions was that in the strong version, the defendant had to be court ordered to give a blood sample while in the weak version, the defendant willingly gave a blood sample. In the ambiguous version, the defendant was reluctant to give a blood sample at first, but ultimately ended up doing so willingly. All other facts were identical in both versions of the DNA case. All versions of the transcripts ended with the judge’s charge to the jury¹⁰.

In order to ensure that the strong, weak, and ambiguous DNA case manipulations were effective, a pilot test was conducted prior to proceeding with Study 1. Forty-five participants were randomly assigned to read one of the three case versions and they subsequently rated from 0 (*Very Weak*) to 100 (*Very Strong*) how strong the DNA evidence was against the defendant (see Appendix F). A one-way ANOVA was conducted in order to examine the differences in ratings between case versions. Results indicated that there was a significant difference in ratings of strength of the DNA evidence as a function of case version ($F(2, 42) = 3.7, p < .05$). A Tukey’s post-hoc test revealed that those who read the Strong DNA case ($M = 67.67, SD = 18.15$) rated the

⁹ The probabilities selected for these transcripts have been used in other DNA jury studies such as Schklar and Diamond (1999) as per their research described earlier in this paper.

¹⁰ A summary of the evidence for the defense and for the crown is presented in Appendix O.

DNA evidence as being significantly stronger than those who read the Weak DNA case ($M = 45.31$, $SD = 29.86$; $p < .05$). Ratings for the Ambiguous DNA case were not significantly different than those for either the Strong DNA or Weak DNA cases. As a result, the decision was made to drop the Ambiguous version and proceed with Study 1 using only the Strong and Weak versions.

Manipulation checks. Participants were asked to determine how strong the DNA evidence was against the defendant in the case they read as well as how strong the prosecutor's and defense's cases were. They did so by rating the strength of the evidence and the strength of the prosecutor's and defense's cases from 0 (*Very Weak*) to 100 (*Very Strong*) (see Appendix F, G, and H, respectively).

Verdict, confidence, and witness credibility. Participants were asked to determine the guilt of the defendant by indicating a value from 0 (*Not Guilty*) to 100 (*Guilty*; See Appendix I). They were also asked to rate how confident they were in their verdict choice from 0 (*Not at all confident*) to 100 (*Extremely Confident*; see Appendix J)¹¹. After the verdict and confidence choices were made, they also rated how credible the expert witness was from 0 (*Not at all credible*) to 100 (*Extremely Credible*; see Appendix K), how persuasive the expert was from 0 (*Not at all persuasive*) to 100 (*Extremely Persuasive*; see Appendix L) and how useful the expert's testimony was from 0 (*Not at all useful*) to 100 (*Extremely Useful*; see Appendix M).

¹¹ Although there is no significant relationship between verdict and verdict confidence in the jury decision making or eyewitness literatures, confidence is being examined in the present studies given that jurors are given a limited case summary and since confidence ratings might indirectly tap into jurors' perceptions of SOE.

Procedure

During the mass testing, participants were required to complete a form that examined their beliefs and attitudes towards DNA evidence (see Appendix A). Participants were asked to indicate on their form whether they would be willing to participate in a future study regarding jury decision making.

From the mass testing, 71 jury eligible participants (as previously described) were selected to take part in a mock jury study based on their responses to the DNA beliefs questionnaire. All participants were required to sign an informed consent sheet. Participants were then randomly assigned to read one of two versions of a transcript of a murder trial: a) strong DNA evidence, or b) weak DNA evidence (see Appendices C and D, respectively). After reading the transcripts, participants rated the strength of the DNA evidence against the accused (see Appendix F), the strength of the Crown's case (see Appendix G), the strength of the defense's case (see Appendix H), the guilt or innocence of the accused (see Appendix I), and their confidence in their verdict choice (see Appendix J). They were also asked to rate how credible they thought the expert witness was (see Appendix K) and how persuasive (see Appendix L) and useful the expert witness' testimony was (see Appendix M). Participants also completed for a second time the same DNA beliefs questionnaire that they completed during mass testing (see Appendix A). This was in order to assess whether jurors' beliefs about DNA were different after having read the trial testimony compared to pre-trial. Once all forms were completed, participants read a written debriefing and the full purpose of the study was explained to them.

Design and Proposed Analyses

The hypotheses were addressed using a 2 x 2 MANOVA. The dependent variables were verdict ratings, confidence, credibility of expert testimony, persuasiveness of expert testimony, and usefulness of expert testimony and the independent variables were strength of evidence (weak, strong) and corresponding DNA belief score (strong positive, skeptical). For the purpose of the MANOVA, the continuous DNA belief score which ranged from 3-15 was made into a categorical variable using the median split procedure previously described with scores falling at or above the median indicating “strong positive” believers, and scores falling below the median indicating “skeptical” believers.

The manipulation check variables were assessed using a one-way MANOVA with rated strength of DNA evidence and rated strength of the Crown’s and defendant’s cases as dependent variables and strength of evidence as the independent variable. A paired-samples *t*-test was also performed on the pre and post DNA beliefs questionnaire scores to examine whether participants’ beliefs changed after participating in the mock jury study.

Results***Data Screening***

Before proceeding with the MANOVA, it was necessary to test whether certain assumptions were satisfied. The first assumption for a MANOVA is that of independence of observations. This is a logical issue in which the researcher must consider whether observations are correlated among participants. In the present research,

given that participants completed the questionnaires on an individual basis, there is no reason to believe that the assumption of independence of observations was violated.

A second assumption is that of multivariate normality. According to Stevens (2002), there is no established statistical test of multivariate normality, however, if univariate normality on each of the dependent variables is present; multivariate normality can be inferred. For each outcome variable, a histogram of the frequency versus regression standardized residuals was examined for normality. With the exception of ratings of expert credibility which displayed a negative skew, all of the outcome variables appeared to be normally distributed. It has been found that deviation from multivariate normality has only a very small effect on Type I error (Everitt, 1979; Hopkins & Clay, 1963; Olson, 1974; Maradia, 1971; see discussion in Stevens, 2002), therefore, the decision was made to proceed with the analyses without transforming the expert credibility rating scores. For this study, given that strength of evidence and beliefs about DNA each only had two levels, it was unnecessary to test for homogeneity of covariance matrices (Stevens, 2002).

Manipulation Checks

Results of the one-way MANOVA revealed that the weak versus strong case version manipulation was effective (Wilk's $\Lambda = .80$, $F(3, 67) = 5.43$, $p < .01$, $\eta^2 = .20$). Univariate analyses revealed that strength of evidence had a significant effect on ratings of the strength of the DNA against the defendant ($F(1, 69) = 12.32$, $p < .001$, $\eta^2 = .88$) and on ratings of the strength of the Crown's case ($F(1, 69) = 10.11$, $p < .001$, $\eta^2 = .89$). Strength of evidence did not have a significant effect on ratings of the strength of the

defendant's case ($F < 1$). Specifically, jurors who read the Strong DNA case ($M = 74.08$, $SE = 3.98$) rated the DNA against the defendant as being significantly stronger than jurors who read the Weak DNA case ($M = 54.20$, $SE = 4.03$). Similarly, jurors who read the Strong DNA case ($M = 66.19$, $SE = 3.55$) rated the Crown's case as being significantly stronger than those who read the Weak DNA case ($M = 50.11$, $SE = 3.60$). See Table 2 for summary statistics. It was predicted that jurors reading the Strong DNA case would rate the defendant's case as being significantly weaker than those reading the Weak DNA case, however, this did not occur. It appears that when DNA evidence is present as part of a trial that jurors automatically associate it with the Crown's case and that therefore, the DNA evidence, regardless of its strength, has little impact on ratings of the defendant's case. Perhaps other pieces of evidence or testimony are more relevant to jurors' ratings of the defendant's case.

Strength of Evidence and Beliefs About DNA

A 2 x 2 MANOVA was used to test the effects of SOE and beliefs about DNA on verdict, verdict confidence, expert credibility, expert persuasiveness, and usefulness of the expert's testimony. For this analysis, the categorical DNA beliefs variable derived from the median split procedure previously described was used. There was no significant interaction between strength of evidence and DNA beliefs ($F < 1$) and no significant main effect of DNA beliefs ($F < 1$). Means and standard errors of DNA beliefs for each of the dependent variables are presented in Table 3. There was, however, a significant main effect of strength of evidence (Wilk's $\Lambda = .74$, $F(5, 63) = 4.37$, $p < .01$, $\eta^2 = .26$).

Table 2

Means and standard errors for manipulation check variables (Study 1).

Dependant Variables	<u>Strong Case</u>			<u>Weak Case</u>			<u>Total</u>		
	<i>M</i>	<i>SE</i>	<i>n</i>	<i>M</i>	<i>SE</i>	<i>n</i>	<i>M</i>	<i>SE</i>	<i>n</i>
Strength of DNA Against Defendant	74.08	3.98	36	54.20	4.03	35	64.28	4.01	71
Strength of Crown's Case	66.19	3.55	36	50.11	3.60	35	58.27	3.58	71
Strength of Defendant's Case	61.36	2.85	36	64.37	2.89	35	62.85	2.87	71

Table 3

Means (SE) for DNA beliefs on all dependent variables

	<u>DNA Beliefs</u>	
	Strong Positive	Skeptical
Dependent Variables		
Verdict	41.39 (3.46)	43.88 (4.42)
Verdict Confidence	75.43 (3.23)	65.86 (4.12)
Expert Credibility	84.48 (2.55)	77.85 (3.26)
Expert Persuasiveness	65.09 (3.48)	53.46 (4.45)
Usefulness of Expert Testimony	59.16 (3.13)	52.53 (4.00)

Univariate analyses revealed that strength of evidence had a significant impact on verdict ratings ($F(1, 67) = 18.47, p < .001, \eta^2 = .22$). Specifically, jurors who read the Strong DNA case ($M = 54.70, SE = 3.92$) gave higher ratings of guilt compared to those who read the Weak DNA case ($M = 30.57, SE = 4.01$). Strength of evidence did not have a significant effect on any of the other dependent variables. See Table 4 for means and standard errors of strength of evidence on the dependent variables.

Pre and Post DNA Beliefs

A *t*-test was conducted in order to examine whether jurors' beliefs about DNA changed from pre to post participation in the study. As was true at pre-test, scores on the three items measuring DNA beliefs at post-test were positively correlated. However, the correlation between the perceived importance of DNA and the perceived frequency with which experts make mistakes about DNA did not reach significance (see Table 5).

Interestingly, jurors' opinions about DNA evidence were significantly lower (or more skeptical) after participating in the experiment ($M = 11.87, SD = 1.68$) compared to at the time of completion of mass testing ($M = 12.37, SD = 1.86; t(70) = 2.61, p < .05$).

Discussion

The purpose of this study was to examine whether jurors' beliefs about DNA evidence impacted on their decisions in a criminal trial when the strength of the evidence was varied. It was predicted that jurors' beliefs about DNA would impact on their verdict ratings, particularly when the trial evidence was weak, however, this prediction was not supported by the results of this study. There are likely many reasons why this was the

Table 4

Means (SE) for Strength of Evidence on all dependent variables for Study 1

	<u>Strength of Evidence</u>	
	Strong	Weak
Dependent Variables		
Verdict	54.70 (3.92)	30.57 (4.01)*
Verdict Confidence	66.54 (3.66)	74.76 (3.74)
Expert Credibility	84.58 (2.90)	77.76 (2.96)
Expert Persuasiveness	59.89 (3.95)	58.66 (4.04)
Usefulness of Expert Testimony	59.21 (3.55)	52.48 (3.63)

Note.

* $p < .001$.

Table 5

Correlations between items measuring DNA beliefs at post-test

	1	2	3
1. How accurate is DNA ?	-	.62**	.23
2. How important is DNA ?	-	-	.46**
3. How often do experts make mistakes about DNA ?	-	-	-

*Note.******* $p < .01$ (2-tailed)

case. For example, in considering the Story Model (Pennington & Hastie, 1992), jurors' beliefs and prior world knowledge are only one element involved in how jurors construct stories based on the information they receive during a trial. It is also important to consider jurors' knowledge about story structures in general, as well as the trial evidence as it is presented. Given that in this study, strength of DNA evidence significantly impacted on verdict ratings, it may be that the evidence itself trumped jurors' preexisting beliefs.

It is recalled that jurors' attitudes and beliefs appear to be particularly influential when the evidence presented in a case is weak or ambiguous versus strong (Jones, 1997; Pfeifer & Ogloff, 1991). In this study, jurors who read the Strong DNA case ($M = 74.08$, $SE = 3.98$) rated the strength of the DNA evidence against the defendant as significantly higher than those who read the Weak DNA case ($M = 54.20$, $SE = 4.03$). However, as can be seen by the value of these means out of 100, the Weak condition rating of 54.20 falls close to the middle range of possible values. Although jurors clearly perceived this evidence as being weaker than that presented in the Strong DNA case, perhaps they did not perceive it to be so weak that they needed to rely on their pre-existing beliefs about DNA in order to fill in the gaps or inconsistencies. In other words, jurors appeared to find the DNA evidence to be "strong" enough in both cases that they relied on it rather than on their own beliefs in reaching a verdict decision. This is in direct support of the second hypothesis of the study which stated that regardless of their beliefs, jurors would render higher guilt ratings when the DNA evidence in the trial was strong versus weak.

In both the strong and weak conditions, the expert witness was rated as highly credible by the jurors. It appears that regardless of the strength of the evidence, jurors viewed the expert witness as a dependable and believable source of information about DNA evidence. As suggested by Schuller (1992), perhaps jurors' opinions about expert witnesses differ more as a function of whether the expert testimony is specific to the case at hand rather than generalized to all similar cases. Schuller's (1992) work found this to be true in cases involving BWS, however, this has not yet been tested in cases involving DNA evidence. Study 2 will examine this possibility.

It is of interest that jurors' opinions about DNA evidence were more skeptical at post-test compared to pre-test. The pre-test measure was completed approximately four months before participants completed the study. Therefore, it is possible that opinions about DNA changed because participants learned more about this type of evidence in some of their university classes. Perhaps participants originally believed that DNA evidence was "infallible" as would seem to be suggested by some crime television programs and other media sources. Between the time they completed the DNA beliefs questionnaire in mass testing and the time they completed it after partaking in the study, participants may have been introduced to the reality that DNA evidence can indeed be prone to errors in the course of some of their psychology or criminology classes.

It is also possible that jurors' beliefs about DNA evidence changed because of some of the information they read in the transcripts while participating in the study. Perhaps the expert witness indirectly affected jurors' beliefs about DNA since it was in the expert's testimony that information about error rates associated with DNA evidence

was presented. It may be that the presentation of error rates made jurors recognize or remember that just because a DNA match is found, it does not mean that the match is correct or absolute. If indeed this is the case, it highlights the importance of expert testimony as a tool for teaching jurors the realistic facts about DNA evidence.

Overall, jurors' beliefs about DNA evidence did not impact on their verdict or confidence ratings, or on their ratings of the expert witness. Instead, strength of the DNA evidence was a more influential factor, particularly with respect to verdict ratings. However, it is possible that jurors' beliefs and interpretations of the statistical meaning of DNA evidence in a trial may influence their decision-making as suggested by Hoffrage and Gigerenzer (1998) and Koehler (1996). Study 2 will examine this issue of statistical presentation of DNA along with type of expert testimony and strength of evidence.

METHOD

Study 2

Participants

Participants were 228 first year psychology students (M age = 20.72, SD = 4.71; n = 156 females) who were jury eligible (as described in Study 1) in Ontario and who had not already participated in Study 1. They were asked to voluntarily take part in a mock-jury study. Compensation for participation was in the form of one experimental course credit. An informed consent sheet was signed by each participant before commencing the experiment.

Materials

Case summary. Participants read one of twelve versions of a 14-page case summary varying statistical presentation (i.e., frequency vs. probability vs. ratio), SOE (i.e., strong vs. weak), and expert testimony (i.e., general vs. specific). The cases describe the fictitious trial of a male defendant accused of murdering his male friend¹². The defendant is pleading not guilty to the charge. Each transcript begins with the judge's instructions to the jury followed by opening statements from the Crown and the Defense. It is established that the defendant and the victim had been playing cards together at the defendant's house earlier in the evening of the night of the murder. The defendant won the game and wanted to collect on the bet the two had made, but the victim refused to pay. An argument ensued and about a half hour after the two walked away from each other, the victim was found dead on the side of the road. The victim was stabbed and blood samples matching those of the defendant were found on the victim.

Witnesses for the Crown, including the police constable who was present at the crime scene, a friend of the defendant, and a neighbour of the defendant are examined by the Crown and then cross-examined by the Defense. Witnesses for the Defense, including the defendant himself, a friend of the defendant, and a woman who noticed suspicious activity in the neighbourhood the night of the murder are examined and then cross-examined by the Crown. The testimony of a forensic scientist serving as an expert witness for the Crown is also presented. In her testimony, the expert witness establishes that she was asked to examine blood samples from the defendant that were used to

¹² Once again, the general format of these transcripts was modeled after transcripts used by Dr. Regina Schuller in her mock jury and expert testimony research.

conduct a DNA test along with the blood samples found on the victim. The results of the DNA testing found a match between the defendant's blood and that found on the victim. The expert witness is then cross examined by the defense lawyer with respect to the possibility of lab errors and random matches associated with DNA testing.

In the specific expert versions (see Appendix N), the expert witness discusses how statistical information about error rates can be presented in different ways (i.e., frequencies vs. probabilities vs. ratios), all of which are equivalent. She gives a numerical example to demonstrate this (i.e., 1 in 1000 = 1000:1 = 0.1%). In the general expert versions (see Appendix N¹³), the expert witness does not explain equivalent statistical presentations and instead only gives the error rate as either a frequency, probability, or ratio. In the weak DNA conditions, the expert testifies that the possibility of a RMP or LE is one of the following: 1 in 50, 50:1, or 2%. In the strong DNA conditions, the expert testifies that the possibility of a RMP or LE is one of the following: 1 in 1,000,000,000, 1,000,000,000:1, or 0.0000001%. Furthermore, in the weak DNA condition, the defendant willingly gave a blood sample while in the strong DNA condition, the defendant was court ordered to give a blood sample. All versions of the transcripts end with the judge's charge to the jury¹⁴.

Manipulation checks. Participants were asked to determine how strong the DNA evidence was against the defendant in the case they read as well as how strong the prosecutor's and defense's cases were. They did so by rating the strength of the evidence

¹³ Since the only difference between the general and specific versions of the expert testimony involves one paragraph describing statistical equivalencies, only one copy of the case is included in the appendices. In the case, it is clearly outlined using footnotes where the differences are across the two versions. The same applies for differences in statistical presentation and strength of evidence.

¹⁴ A summary of the evidence for the defense and for the crown is presented in Appendix O.

and the strength of the prosecutor's and defense's cases from 0 (*Very Weak*) to 100 (*Very Strong*) (see Appendix F, G, & H, respectively).

Verdict, confidence, and expert witness ratings. Participants were asked to determine the guilt of the defendant by indicating a value from 0 (*Not Guilty*) to 100 (*Guilty*; See Appendix I). They were also asked to rate how confident they were in their verdict choice from 0 (*Not at all confident*) to 100 (*Extremely Confident*; see Appendix J). Participants also rated how credible the expert witness was from 0 (*Not at all credible*) to 100 (*Extremely Credible*; see Appendix K), how persuasive the expert was from 0 (*Not at all persuasive*) to 100 (*Extremely persuasive*; see Appendix L), and how useful the expert's testimony was from 0 (*Not at all useful*) to 100 (*Extremely useful*; see Appendix M). They were also asked how easy it was to understand the statistics that were presented to them in the transcript from 0 (*Extremely difficult*) to 100 (*Extremely easy*; see Appendix P).

Procedure

Upon signing an informed consent sheet, participants were randomly assigned to one of 12 conditions in a 3 (statistical presentation: frequency vs. probability vs. ratio) x 2 (SOE: strong vs. weak) x 2 (expert testimony: general vs. specific) experimental design. They then read the 14-16 page case summary corresponding to the condition they were randomly assigned to. After reading the transcript, participants were required to rate the strength of the evidence and the strength of the prosecutor's and defense's cases (see Appendices F, G, & H, respectively). They were also asked to rate the credibility and persuasiveness of the expert witness as well as the usefulness of her testimony, how easy

it was to understand the statistical information presented (see Appendices K, L, M, and P) and to rate the guilt or innocence of the accused (see Appendix I) as well as their confidence in their verdict (see Appendix J). Once all forms were completed, participants were debriefed and the full purpose of the study was explained to them.

Design and Proposed Analyses

The hypotheses for Study 2 were addressed using a 3 (statistical presentation: frequency vs. probability vs. ratio) x 2 (SOE: strong vs. weak) x 2 (expert testimony: specific vs. general) MANOVA with verdict ratings, confidence, expert credibility, expert persuasiveness, usefulness of expert's testimony, and ease of understanding of statistical information as the dependent variables. The manipulation check variables were assessed using a one-way MANOVA with rated strength of DNA evidence and rated strength of the Crown's and defendant's cases as dependent variables and strength of evidence as the independent variables.

Results

Data Screening

As was true in Study 1, it was necessary to test whether certain assumptions were satisfied before proceeding with the analyses. With respect to independence of observations, there was no reason to believe that this assumption was violated given that participants completed their questionnaires individually and without consultation with other participants. Furthermore, participants who took part in Study 2 were not the same participants that completed Study 1.

The normality assumption was also tested. For each outcome variable, a histogram of the frequency versus regression standardized residuals was examined for normality. With the exception of ratings of expert credibility and verdict confidence which displayed a negative skew, all of the outcome variables appeared to be normally distributed. As previously mentioned, it has been found that deviation from multivariate normality has only a very small effect on Type I error (Everitt, 1979; Hopkins & Clay, 1963; Olson, 1974; Maradia, 1971; see discussion in Stevens, 2002), therefore, the decision was made to proceed with the analyses without transforming the expert credibility or verdict confidence rating scores.

The assumption of homogeneity of covariance matrices was tested for the analysis involving the Statistical Presentation of DNA variable, given that it had more than two levels (e.g., frequency, probability, and ratio). Homogeneity of covariance matrices is tested by the use of the Box test, and if this test is significant, there is a violation of the assumption. Stevens (2002) indicates that a violation of homogeneity of covariance matrices is not serious if the group sizes are relatively equal (e.g., largest group/smallest group < 1.5), but that a violation is serious only when the group sizes are sharply unequal. The Box test was found to be significant at $p < .01$, thus indicating heterogeneity of covariance matrices. However, the ratio between the largest and smallest groups (e.g., Probability, $n = 78$ vs. Frequency, $n = 74$) is less than 1.5, therefore, the violation is not considered serious and there is no need to perform transformations (Stevens, 2002).

Manipulation Checks

Results of the one-way MANOVA revealed that the weak versus strong case version manipulation was effective (Wilk's $\Lambda = .91$, $F(3, 224) = 7.51$, $p < .001$, $\eta^2 = .10$). Univariate analyses revealed that strength of evidence had a significant effect on ratings of the strength of the DNA against the defendant ($F(1, 226) = 14.05$, $p < .001$, $\eta^2 = .06$), on ratings of the strength of the Crown's case ($F(1, 226) = 17.35$, $p < .001$, $\eta^2 = .07$), and on strength of the defendant's case ($F(1, 226) = 5.72$, $p < .05$, $\eta^2 = .03$).

Specifically, jurors who read the Strong DNA case ($M = 65.24$, $SE = 2.28$) rated the DNA against the defendant as being significantly stronger than jurors who read the Weak DNA case ($M = 53.28$, $SE = 2.24$). Similarly, jurors who read the Strong DNA case ($M = 64.28$, $SE = 2.01$) rated the Crown's case as being significantly stronger than those who read the Weak DNA case ($M = 52.53$, $SE = 1.98$). Finally, jurors who read the Strong DNA case ($M = 62.86$, $SE = 1.71$) rated the defendant's case as being significantly weaker than those who read the Weak DNA case ($M = 68.58$, $SE = 1.68$). See Table 6 for summary statistics.

Strength of Evidence, Expert Testimony, and Statistical Presentation

Main effects. A $3 \times 2 \times 2$ MANOVA was used to test the effects of type of statistical presentation (i.e., frequency vs. probability vs. ratio), strength of evidence (i.e., strong vs. weak), and type of expert testimony (i.e., general vs. specific) on verdict, verdict confidence, expert credibility, expert persuasiveness, usefulness of the expert's

Table 6

Means and standard errors for manipulation check variables (Study 2).

Dependant Variables	<u>Strong Case</u>			<u>Weak Case</u>			<u>Total</u>		
	<i>M</i>	<i>SE</i>	<i>n</i>	<i>M</i>	<i>SE</i>	<i>n</i>	<i>M</i>	<i>SE</i>	<i>n</i>
Strength of DNA Against Defendant	65.24	2.28	112	53.28	2.24	116	59.15	2.26	228
Strength of Crown's Case	64.28	2.01	112	52.53	1.98	116	58.30	1.99	228
Strength of Defendant's Case	62.86	1.71	112	68.58	1.68	116	65.77	1.69	228

testimony, and ease of understanding of statistical information. A significant main effect of strength of evidence was found (Wilk's $\Lambda = .81$, $F(6, 211) = 8.08$, $p < .001$, $\eta^2 = .19$). Univariate analyses revealed that strength of evidence had a significant impact on verdict ($F(1, 216) = 40.47$, $p < .001$, $\eta^2 = .16$). Specifically, jurors who read the strong case versions ($M = 54.21$, $SE = 2.05$) gave higher ratings of guilt compared to those who read the weak case version ($M = 35.91$, $SE = 2.02$). Strength of evidence also had a significant impact on ratings of expert persuasiveness ($F(1, 216) = 5.30$, $p < .05$, $\eta^2 = .02$). In particular, jurors who read the strong case versions ($M = 68.02$, $SE = 2.37$) rated the expert witness as being significantly more persuasive than those reading the weak case versions ($M = 60.37$, $SE = 2.33$).

A significant main effect of type of statistical presentation was also found (Wilk's $\Lambda = .78$, $F(12, 422) = 4.59$, $p < .001$, $\eta^2 = .12$). Upon examination of univariate analyses, it was found that type of statistical presentation had a significant impact on verdict ($F(2, 216) = 19.08$, $p < .001$, $\eta^2 = .15$). Results of a Tukey's post hoc test revealed that jurors who read cases where the DNA error rates were presented as frequencies ($M = 57.48$, $SE = 2.53$) gave higher guilt ratings than both jurors who read error rates presented as probabilities ($M = 40.97$, $SE = 2.46$, $p < .001$) and jurors who read error rates presented as ratios ($M = 36.73$, $SE = 2.49$, $p < .001$).

Statistical presentation also had a significant impact on ratings of expert persuasiveness ($F(2, 216) = 7.36$, $p < .01$, $\eta^2 = .06$). Tukey's post hoc analyses indicated that jurors who read the cases with the DNA error rates presented as frequencies rated the expert as being significantly more persuasive ($M = 72.68$, $SE = 2.92$) than both jurors

who read error rates presented as probabilities ($M = 62.75$, $SE = 2.84$, $p < .05$) and jurors who read error rates presented as ratios ($M = 57.16$, $SE = 2.88$, $p < .01$).

A significant impact of statistical presentation on ratings of the usefulness of the expert's testimony was also found ($F(2, 216) = 7.14$, $p < .01$, $\eta^2 = .06$). Follow-up analyses using the Tukey test revealed that jurors who read cases with DNA error rates presented as frequencies rated the expert's testimony to be significantly more useful ($M = 68.86$, $SE = 3.19$) than both jurors who read error rates presented as probabilities ($M = 56.43$, $SE = 3.11$, $p < .05$) and jurors who read error rates presented as ratios ($M = 52.67$, $SE = 3.14$, $p < .01$).

Finally, a significant impact of statistical presentation on ratings of the ease of understanding of statistical information was found ($F(2, 216) = 4.39$, $p < .05$, $\eta^2 = .04$). The follow-up Tukey's test revealed that jurors who read cases with DNA error rates presented as probabilities ($M = 84.78$, $SE = 2.45$) rated the statistics presented in the case transcripts as being easier to understand than jurors who read error rates presented as ratios ($M = 74.52$, $SE = 2.48$, $p < .05$). There was no main effect for expert testimony. See Tables 7 to 9 for means and standard errors of strength of evidence, expert testimony, and statistical presentation (respectively) on the dependent variables.

Interaction. Although there was no significant main effect of type of expert testimony, a significant interaction between type of expert testimony and statistical presentation was found (Wilk's $\Lambda = .90$, $F(12, 422) = 1.82$, $p < .05$, $\eta^2 = .05$). See Figure 3 for a graph of the interaction. Univariate analyses revealed a significant interaction on verdict ($F(2, 216) = 4.83$, $p < .01$, $\eta^2 = .04$). Simple main effects for expert testimony at

Table 7

Means (SE) for Strength of Evidence on all dependent variables for Study 2

	<u>Strength of Evidence</u>	
	Strong	Weak
Dependent Variables		
Verdict	54.21 (2.05)	35.92 (2.02)**
Verdict Confidence	74.89 (1.77)	76.39 (1.74)
Expert Credibility	83.59 (1.94)	81.80 (1.90)
Expert Persuasiveness	68.02 (2.37)	60.37 (2.33)*
Usefulness of Expert Testimony	59.05 (2.59)	59.59 (2.55)
Understanding of Statistics	79.82 (2.04)	80.20 (2.01)

Note.

* $p < .05$; ** $p < .001$.

Table 8

Means (SE) for Expert Testimony on all dependent variables

	<u>Expert Testimony</u>	
	Specific	General
Dependent Variables		
Verdict	46.68 (2.04)	43.45 (2.03)
Verdict Confidence	74.60 (1.76)	76.68 (1.74)
Expert Credibility	81.13 (1.93)	84.27 (1.91)
Expert Persuasiveness	65.07 (2.36)	63.33 (2.34)
Usefulness of Expert Testimony	59.71 (2.58)	58.93 (2.56)
Understanding of Statistics	78.78 (2.03)	81.24 (2.02)

Table 9

Means (SE) for Statistical Presentation on all dependent variables.

<u>Dependant Variables</u>	<u>Frequency</u>	<u>Probability</u>	<u>Ratio</u>
Verdict	57.48 (2.53) ^a	40.97 (2.46)	36.73 (2.49)
Verdict Confidence	74.45 (2.17)	75.52 (2.12)	76.95 (2.14)
Expert Credibility	84.20 (2.38)	82.90 (2.32)	81.00 (2.35)
Expert Persuasiveness	72.68 (2.92) ^b	62.75 (2.84)	57.16 (2.88)
Usefulness of Expert Testimony	68.86 (3.19) ^c	56.43 (3.11)	52.67 (3.14)
Understanding of Statistics	80.73 (2.51)	84.78 (2.45) ^d	74.52 (2.48)

Note.

^a Mean significantly higher than both probability and ratio means ($p < .001$).

^b Mean significantly higher than both probability and ratio means ($p < .01$).

^c Mean significantly higher than both probability and ratio means ($p < .01$).

^d Mean significantly higher than ratio mean ($p < .05$).

Figure 3. Graph of Significant Interaction Between Type of Expert Testimony and Statistical Presentation.

each level of statistical presentation were examined and a family-wise error rate of $p < .05$ was held using a Bonferroni correction ($.05 / 3 = .02$) for multiple comparisons. Results revealed that only differences within the specific expert conditions were significant (Wilk's $\Lambda = .77$, $F(12, 422) = 4.96$, $p < .001$, $\eta^2 = .12$). Within the specific expert condition, significant differences were found for verdict ratings ($F(2, 216) = 21.35$, $p < .001$, $\eta^2 = .17$). Jurors reading DNA error rates presented as frequencies ($M = 65.33$, $SE = 3.58$) gave higher guilt ratings than jurors reading error rates presented as either probabilities ($M = 40.61$, $SE = 3.47$, $p < .001$) or ratios ($M = 34.09$, $SE = 3.57$, $p < .001$).

Similarly, within the specific expert condition, differences were found for ratings of expert witness persuasiveness ($F(2, 216) = 5.96$, $p < .01$, $\eta^2 = .05$). Jurors reading DNA error rates presented as frequencies ($M = 72.82$, $SE = 4.13$) rated the expert witness as being more persuasive than jurors who read error rates presented as ratios ($M = 53.71$, $SE = 4.12$, $p < .01$). In turn, those who read DNA error rates presented as probabilities ($M = 68.66$, $SE = 4.01$) rated the expert to be more persuasive than those who read error rates presented as ratios ($p < .05$).

Finally, differences were found for ratings of the usefulness of the expert testimony within the specific expert condition ($F(2, 216) = 4.60$, $p < .05$, $\eta^2 = .04$). The only significant difference found was that jurors who read the case with DNA error rates presented as frequencies ($M = 69.65$, $SE = 4.52$) rated the expert's testimony to be more useful than those who read error rates presented as ratios ($M = 50.32$, $SE = 4.51$, $p < .01$).

Simple main effects for statistical presentation at each level of expert testimony were also examined, again with a family-wise error rate of $p < .05$ held using a Bonferroni correction ($.05 / 3 = .02$) for multiple comparisons. Results revealed that differences within the frequency statistical presentation were marginally significant (Wilk's $\Lambda = .94$, $F(6, 211) = 2.12$, $p = .052$, $\eta^2 = .06$). More specifically, differences within frequency presentation were found for verdict ($F(1, 216) = 9.65$, $p < .01$, $\eta^2 = .04$). Jurors who read the case with the specific expert ($M = 65.33$, $SE = 3.58$) gave higher guilt ratings than those who read the case with the general expert ($M = 49.64$, $SE = 3.57$, $p < .01$). No other significant simple main effects were found.

Discussion

The purpose of this study was to examine the impact of different forms of statistical presentation, expert testimony, and SOE on jury decision-making. The hypotheses for Study 2 were partially supported. Although there was no interaction between SOE and statistical presentation on verdict, both SOE and statistical presentation showed significant main effects. As was true in Study 1, jurors who read the strong case versions gave higher guilt ratings for the defendant compared to jurors who read the weaker case versions. Jurors who read the strong case versions also rated the expert witness as being more persuasive than those reading the weak case versions. Given that part of what made the case versions weak versus strong was related to the DNA evidence provided by the expert witness, it makes sense that jurors would rate the expert as being more persuasive when the evidence is strong. Interestingly, as was seen in Table 5, the expert witness was rated as highly credible regardless of SOE. Jurors therefore appeared

to view the expert witness as being an important and believable source of information with respect to DNA evidence independent of SOE, however, the persuasiveness of the expert was heightened when the DNA evidence was strong. This is in keeping with Schuller's (1992) work which found that jurors view expert witnesses as a believable source of information with respect to the evidence and circumstances in BWS cases.

Statistical presentation of the error rates associated with the DNA evidence had an impact on verdict, ratings of expert persuasiveness, ratings of the usefulness of the expert testimony, and ratings of how easy it was to understand the statistical information provided in the transcripts. As discussed by Koehler, Chia, and Lindsay (1995), jurors are not able to effectively combine separate LE and RMP estimates even when they are taught how to do so, therefore, in the present study, one combined LE and RMP estimate was provided. Doing so has been found to be effective in other studies (i.e., Schklar & Diamond, 1999). In the current study, higher ratings for verdict (indicating more guilt), expert persuasiveness, and usefulness of the expert testimony were given by jurors who were presented with DNA error rates as frequencies compared to probabilities or ratios. These results support the findings of Gigerenzer and Hoffrage (1995) and Sedlmeier and Gigerenzer (2001) who suggested that humans understand frequency formats better than other types of statistical formats because they correspond better to humans' natural cognitive algorithms and the way people naturally acquire information. The results also support Koehler's (1996) finding that jurors have an easier time interpreting DNA evidence presented as frequencies over other types of statistical formats. There were no

differences found between the probability and ratio DNA evidence formats with respect to juror's ratings on guilt, expert persuasiveness, or usefulness of expert's testimony.

It is interesting to note that with respect to ratings of how easy it was to understand the statistical information in the cases, jurors who were presented with probability DNA error rates rated the statistics as significantly easier to understand than jurors who were presented with ratio DNA error rates. In fact, though not statistically significant, jurors rated probabilities as being easier to understand than frequencies. These ratings appear to contradict how the jurors actually performed with respect to their various other ratings on the dependent variables as described above. On the one hand, jurors seem to believe that probabilities are easiest to understand, however, on the other hand, when it comes to decision-making in a trial, jurors unknowingly have an easier time interpreting and applying frequencies. Given that the statistics presented were equivalent regardless of presentation form, the implication is that jurors need to be made aware of how to translate or re-represent probabilities and ratios into frequencies so that the information is more congruent with their natural cognitive algorithms (Sedlmeier & Gigerenzer, 2001).

Indeed, the fact that a significant interaction was found between type of expert testimony and statistical presentation suggests that jurors can be "taught" how to re-represent other forms of statistics into frequencies. Recall that in the specific expert testimony transcripts, the expert witness demonstrated through an example how different types of statistical formats can be numerically equivalent. Within the specific expert condition, jurors who read DNA error rates presented as frequencies gave higher guilt

ratings than jurors who read probability or ratio DNA error rates. Jurors reading frequency DNA error rates also rated the expert to be both more persuasive and to have more useful testimony in comparison to jurors who read ratio DNA error rates. Furthermore, within the frequency condition, jurors who were presented with expert testimony specifically addressing DNA statistical equivalencies rated the defendant as significantly more guilty than jurors who were presented with general expert testimony. Therefore, specific expert testimony that demonstrates to jurors how to interpret various forms of statistical DNA appears to have an impact on their decision-making, particularly with respect to verdict. This is in line with other research that suggests that expert testimony that is specific to the case at hand rather than generalized to all similar cases influences jurors' verdict ratings (Schuller, 1992).

It was expected that there would be an interaction between SOE and statistical presentation and between SOE and expert testimony, however, this was not the case in the present study. Perhaps, as suggested in Study 1, if jurors deem the DNA evidence in a case to be strong enough, other factors such as the expert's testimony or how the statistics are presented, though still important, may matter less in terms of ultimate decision making. Stated differently, it may be that the presence of strong DNA evidence in and of itself is a more powerful influence on jurors' decisions than other potentially important factors.

It is unknown whether or not there would have been a significant interaction between SOE, statistical presentation, and expert testimony if the jurors had had a chance to deliberate. The present study could not assess this given that jurors participated

individually rather than as a collective. It is likely that during the deliberation period, jurors would have discussed factors other than SOE and perhaps significant interactions between SOE, statistical presentation, and expert testimony would have resulted. It is always hard to disentangle why a jury makes certain decisions based on its deliberations given that a number of factors (i.e., personality, authority, fatigue, etc.) have an effect, however, future research should attempt to examine the relationship between SOE, statistical presentation, and expert testimony with deliberating juries.

GENERAL DISCUSSION

According to the Story Model of jury decision-making (Pennington & Hastie, 1986, 1988) many factors interact in order to explain how jurors arrive at their ultimate verdict decisions. Among these factors are the trial evidence itself and jurors' pre-existing beliefs and knowledge. In the first study, it was hypothesized that there would be an interaction between SOE and jurors' pre-existing beliefs about DNA evidence, however, this was not the case. Instead, SOE appeared to have the biggest impact on jurors' verdict decisions. When the DNA evidence against the defendant was strong, jurors gave higher ratings of guilt than when the evidence was weak. As previously discussed, it may be that jurors did not feel that the evidence in the weak condition was so weak that they needed to rely on their beliefs to fill in the holes and inconsistencies in the trial.

Research examining human reasoning under uncertainty both legally and generally finds that interpretation of statistics can be problematic but that statistics provided in a frequency format are more easily understood than probabilities or ratios

(Gigerenzer & Hoffrage, 1995; Koehler, 1996). As an extension of the Story Model, if jurors in court cases find statistical evidence to be weak or confusing, they may rely more on their existing beliefs in arriving at a verdict decision. The results of Study 2 suggest that once again, SOE is an import factor in jury decision-making. The results also demonstrate that while jurors may believe that probability statistics are the easiest to understand, they do a better job of interpreting frequency statistics which are consistent with how humans naturally acquire information (Sedlmeier & Gigerenzer, 2001). Furthermore, there is some support for the notion that expert testimony can be used as a tool for clarifying statistical confusions that jurors may have and that it can help to counteract beliefs that jurors might hold (Schuller et al., 2004). In particular, Study 2 showed that within the frequency method of statistical presentation, specific expert testimony that demonstrates how various forms of statistics can be numerically equivalent led to higher ratings of guilt than the general expert testimony.

Implications

This research has both theoretical and practical implications for the field of criminal justice. Theoretically, although jurors' beliefs about DNA evidence did not interact with SOE to influence verdict decisions, the Story Model indicates that jurors will fall back on their beliefs only when they are attempting to fill in gaps or inconsistencies that are inherent in a trial (Pennington & Hastie, 1986, 1988). As suggested by the results in Study 1, perhaps jurors did not find the DNA evidence in the weak condition to be so inconsistent or problematic that they needed to rely on their beliefs to guide their verdict choices. A practical implication of these results for lawyers

is that they may want to carefully assess potential jurors' beliefs about DNA before making final jury selections, particularly if the DNA evidence in their case is very weak. They may need to be less concerned about jurors' beliefs if the DNA evidence is strong or moderate. Perhaps a more standardized questionnaire examining jurors' beliefs about DNA could be developed and given to potential jurors as a screening tool.

Although not specifically tested in this research, it is also possible that jurors' pre-conceived beliefs about other types of forensic evidence (i.e., fingerprints, ballistics, fibre analysis, etc.) may play a role in their verdict choices when the corresponding evidence in a trial is weak. Indeed, the Story Model would support this idea. The challenge for the justice system is in attempting to determine to what extent jurors' beliefs guide their decision-making and under what circumstances. Furthermore, if jurors' beliefs about forensic evidence are erroneous or misguided, and heavy weight is placed on these beliefs in reaching a verdict, this could seriously jeopardize the fairness of a trial. It becomes even more complex when one considers how individual jurors' beliefs come together and get sorted out during the process of group jury deliberations. It is highly unlikely that each juror comes to the table with the same beliefs about the evidence presented at the trial, yet, as a collective, the jury must reach a unanimous verdict. Since beliefs will always have an influence on jurors to one degree or another, it is important to find a way to make sure that the fairness of the trial is preserved. One strategy would be to ensure that jurors are accurately educated about forensic evidence before they enter the courtroom and before they deliberate.

Education for jurors on DNA and other types of forensic evidence could be accomplished through participation in a mini-course prior to the start of the trial. This could be a one to two day course taught by an expert in forensic science that covers various forms of forensic evidence, including how each is collected at the crime scene and analyzed in the laboratory, and a discussion of error rates associated with each form of evidence. In this forum, common myths about DNA and other forensic evidence could be discussed and the myths could be replaced with factual information. If, as previously suggested, a screening questionnaire is used to better understand jurors' preconceived beliefs about DNA, the results of this questionnaire could guide the development of the mini-course content with respect to jurors' educational needs. Participation in a mini-course by *all* jurors, regardless of prior knowledge about DNA and forensic evidence, would be important in order to ensure that everyone gets the same information in as standardized a manner as possible.

From a theoretical standpoint, this research also adds to the body of knowledge about how humans process statistical information. As was found in Study 2, what jurors believe to be true about statistics does not always translate into how they interpret or use the statistics to make decisions. The research illustrates how the same statistical information presented in different formats (i.e., probabilities or ratios) can be confusing if it does not conform to how humans naturally process information (i.e., in frequency formats). Specifically, since frequency formats appear to be more easily interpreted and applied, this provides a compelling rationale for ensuring that frequencies, as opposed to probabilities or ratios be routinely used in cases involving DNA evidence. In light of

these findings, it is recommended that the courts consider presenting results associated with DNA evidence, regardless of whether they come from the Crown or defense, in frequency format rather than in some alternate format. This would also be recommended for the presentation of results associated with other forms of forensic evidence besides DNA. The consistent use of frequency formats by the courts could help to make the juror's task of interpreting statistical information less daunting and frustrating. It would also provide a common language for DNA statistics within the legal system.

Moreover, since it was found that expert witnesses were able to help clarify potentially confusing statistics by presenting them in alternate, yet equivalent formats, it would be both logical and practical to have expert testimony that specifically addresses these types of statistical issues anytime that DNA evidence is presented in court. It would therefore be ideal to have an expert witness who is knowledgeable not only in the forensic evidence itself, but who is also knowledgeable in statistics. In some cases, it may be necessary to have two or more separate expert witnesses in order to accomplish this. Furthermore, if jurors are going to take a mini-course before the trial, it would be beneficial to include some pre-trial training from a statistical expert. This way, jurors would be exposed to statistical issues both before and during trial which could help to solidify the information they would learn.

Limitations

Some of the methodological limitations of this research should be noted. As with any mock jury study, results may not be generalizable to real-life cases given the artificial nature of the task. In particular, the ecological validity of the current mock jury studies is

difficult to estimate given that mock jurors may not feel the same degree of pressure to make the “right” decision that real jurors do. Similarly, although the mock trial transcripts were long enough to provide the jurors with several pieces of evidence to consider, they cannot replicate the experience of participating in a live trial and being face-to-face with the judge and the various attorneys and witnesses. Furthermore, reading ability of the participants in the studies was not assessed, therefore, it is possible that reading through the transcripts was a more challenging task for some participants than for others. The use of undergraduate university students as participants is also a limitation since they tend to be young, middle-class, and well educated (Schuller, 1992). These characteristics are not necessarily representative of the general population from which jurors are normally selected. Future research should attempt to use a more diverse group of potential jurors.

Another limitation of this research is that participants responded individually unlike real jurors who have the chance to deliberate amongst themselves. If deliberations had occurred, it is possible that a different pattern of results would have emerged. However, the study of deliberating groups has challenges of its own given that so many group factors and dynamics can contribute to the juries’ decisions. Given that the present study is the first to examine the relationship between beliefs, SOE, statistical presentation, and expert testimony, it was decided that having participants respond individually was preferable in order to understand the impact of these variables on jury decision making independent of various group dynamics. Given the significance of some

of the findings, future research should attempt to study the relationships among these variables when jurors deliberate as a group.

Finally, the way in which DNA beliefs were measured can be considered a limitation of the study. This was the first study to attempt to systematically measure people's beliefs about DNA and then apply these beliefs in a mock jury study. As a result, there was no empirically derived measure available to assess people's beliefs about DNA. The researcher therefore developed three questions as a preliminary way of finding out what people believe about DNA. Given the nature of these questions, it may be that the responses assessed people's general knowledge about DNA rather than their beliefs and attitudes. Therefore, different or additional questions could have done a better job of tapping into people's beliefs about DNA. Future studies could attempt to develop a valid and reliable measure of DNA beliefs. This would be a useful tool for other researchers who are interested in studying the impact of beliefs about DNA on jury decision-making.

Future Research

Future research would do well to attempt to replicate the current findings with groups of deliberating juries whose members are representative of the general public. Furthermore, the development of standardized measures testing people's beliefs about DNA would be useful.

Another interesting line of future research follows from the finding in Study 1 that jurors' beliefs about DNA evidence were more skeptical at post-test compared to pre-test. Why and under what conditions do people's beliefs about DNA change? In this study, it

may be that participants became more educated about DNA evidence in the course of their studies and that they gained a better understanding of the fact that DNA evidence is fallible. It could also be that this learning occurred through the reading of the transcripts since the notion of error rates associated with DNA was introduced. Another related area for future research would be the examination of how exposure to various forms of media can potentially influence jurors' beliefs about DNA. Some researchers have started to examine the supposed "CSI Effect" in which people are thought to gain unrealistically optimistic opinions about DNA evidence (by watching televised crime dramas) to the point that they view it as almost infallible. It may be that there are television programs and other media sources that actually do impart accurate information about DNA and that these sources cause changes in people's beliefs about DNA.

Finally, future research could take a more detailed look at which pieces of information (or combination thereof) presented in a trial cause jurors to view DNA evidence as either strong or weak. In the present studies, strength of DNA evidence was manipulated by varying error rates associated with DNA and willingness of the defendant to give a blood sample. Future studies could look at these two factors independently to determine how they uniquely affect jurors' ratings of SOE, and ultimately, their verdict decisions. Conversely, future research could examine how various other combinations of factors influence jurors' perceptions of SOE (i.e., alibi evidence, presence of the murder weapon, etc.). Realistically, jurors are presented with numerous pieces of information during a trial that they must incorporate into their perceptions of SOE and their verdict choices, therefore, future research in this area is needed.

CONCLUSION

DNA evidence will likely continue to have a powerful influence on jurors' verdict decisions in criminal cases for years to come. As a result, it is important to ensure that those who are chosen to serve on juries have as much accurate information about DNA as possible and that they understand the meaning of statistics associated with DNA evidence in court. Expert testimony that specifically addresses statistical issues surrounding DNA evidence is one way of achieving this. In the absence of proper information and understanding, jurors may rely on their own beliefs about DNA in arriving at a verdict decision, particularly if they perceive the overall evidence in the trial to be weak. Beliefs and biases will always impact on jurors' decisions to some degree as suggested by the Story Model. However, since the lives of so many victims and defendants are in the hands of a jury, it is the responsibility of the legal system to find a way to educate jurors so that they make the fairest and most accurate verdict decisions possible.

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Appendix A
DNA Beliefs

Age _____

Gender (please circle): M F

Ethnic Origin: _____

Language you are most comfortable speaking: _____

Have you ever served on a jury in Canada? Yes No

If yes, when? _____

This questionnaire is designed to examine your knowledge about common types of evidence in criminal hearings in Canadian Courts. Please circle the answer or number that best corresponds to what you think.

1. How important is fingerprint evidence in determining the guilt of an accused criminal?

1	2	3	4	5
Not at all important	A little important	Somewhat important	Very important	Extremely important

2. How accurate is fingerprint evidence?

1	2	3	4	5
Not at all valid	A little valid	Somewhat valid	Very valid	Extremely valid

3. How often do expert witnesses make mistakes about fingerprint evidence (i.e., that they are wrong when they report a fingerprint match with the accused)?

1	2	3	4	5
Never	Seldom	Sometimes	Often	Always

4. How important is hearsay evidence (i.e., when information presented by a witness was obtained from a secondary source rather than seen or heard directly by the witness) in proving the guilt/innocence of an accused criminal?

1	2	3	4	5
Not at all important	A little important	Somewhat important	Very important	Extremely important

5. How accurate is heresay evidence?

1	2	3	4	5
Not at all accurate	A little accurate	Somewhat accurate	Very accurate	Extremely accurate

6. How often do expert witnesses make mistakes about heresay evidence (i.e., that they report the information provided by the secondary source inaccurately)?

1	2	3	4	5
Never	Seldom	Sometimes	Often	Always

7. How important is DNA evidence in determining the guilt of an accused criminal?

1	2	3	4	5
Not at all important	A little important	Somewhat important	Very important	Extremely important

8. How accurate is DNA evidence?

1	2	3	4	5
Not at all accurate	A little accurate	Somewhat accurate	Very accurate	Extremely accurate

9. How often do forensic scientists make mistakes about DNA evidence (i.e., that they are wrong when they report a DNA match with the accused)?

1	2	3	4	5
Never	Seldom	Sometimes	Often	Always

10. How important is fibre analysis evidence (i.e., matching of fibres found at the crime scene with fibres of an accused person's clothing) in determining the guilt of an accused criminal?

1	2	3	4	5
Not at all important	A little important	Somewhat important	Very important	Extremely important

11. How accurate is fiber analysis evidence?

1	2	3	4	5
Not at all accurate	A little accurate	Somewhat accurate	Very accurate	Extremely accurate

12. How often do expert witnesses make mistakes about fiber analysis evidence (i.e., that they are wrong when they report a fiber match with the accused)?

1	2	3	4	5
Never	Seldom	Sometimes	Often	Always

**Would you be willing to take part in a future study about jury decision-making?
(You would receive an additional experimental credit) Yes No**

If yes, please indicate your name, student number, and email address so that the researcher may contact you.

Appendix B

Exclusionary Criteria for Jury Service in Ontario (from Granger, 1996)

“The following are ineligible under the [Juries] Act for jury service:

- a) every member of the Privy Council of Canada or the Executive Council of Ontario;
- b) every member of the Senate, House of Commons of Canada or Assembly;
- c) every judge and justice of the peace;
- d) every barrister and solicitor and student-at-law;
- e) every legally qualified medical practitioner and veterinary surgeon actively engaged in practice and every coroner;
- f) every person in the enforcement of law including, without restricting the generality of this, sheriffs, wardens of any penitentiary, superintendents, jailers or keepers of prisons, correctional institutions or lockups, sheriff's officers, police officers, and officers of a court of justice;
- g) a person who has a physical or mental disability that would seriously impair the ability to discharge jury duties;
- h) a person who has been convicted of an indictable offence, unless subsequently granted a pardon.”

Appendix C (Strong DNA)

Thank you for agreeing to take part in this research.

On the following pages is a summary of a trial transcript. Please read the transcript and try to imagine yourself as a juror faced with this evidence. Once you have read through the trial, you will be asked to answer some questions.

Please treat this as an independent exercise. We are interested in your opinions and therefore it is very important for the purposes of the research that you refrain from discussing the case with other people who may be participating in this study.

Judge's Instructions

Jim Anton has been charged with the crime of murder in the first degree. The Crown has the burden of proving that charge beyond a reasonable doubt. It is your duty to read all of the evidence, to decide the facts, and then to apply the law that I give you at the end of the trial.

The case will begin with opening statements from the prosecution and the defense attorneys. Each will tell you what they expect to prove. These statements are not evidence, they are only a summary to help you follow the case.

The prosecution will then call witnesses for the Crown. After the prosecution has finished questioning a witness, counsel for the accused will be allowed to question the same witness. After all the witnesses for the prosecution have been heard, the accused's attorney may choose to present witnesses on the accused's behalf.

Prosecution's Opening Statement

Darren Williams (deceased) and Jim Anton (accused) were friends aged 31 and 34 years old, respectively who lived in the city of Toronto. They met several years ago when they were both studying together at the University of Toronto.

Witnesses will testify regarding the events that transpired the evening of the killing. On this night, Jim, Darren, and two other male friends played cards at Jim's house. The men decided to place monetary bets on their card games, and by the end of the evening, Darren owed Jim one thousand dollars. Jim asked to collect the money that Darren owed him, but Darren refused to pay. Darren went to leave Jim's house, and Jim followed him outside where an argument over the money ensued between the two men. The two men walked away from each other after the argument and Jim was still extremely angry. About a half hour after they walked away from each other, the victim, Darren Williams, was found dead on the side of the road.

Witnesses will testify that Jim had been heard not only making death threats towards Darren, but that Jim has a history of verbal and physical violence towards others. Two witnesses will testify that on the night of the murder, Jim said to Darren, "If you don't pay up, I'm going to kill you."

Forensic examinations revealed that Darren Williams was killed by multiple stab wounds to the chest inflicted by a machete. Blood samples were found on Darren William's body near his stab wounds and you'll hear from an expert witness that the DNA in those blood samples matched the DNA in blood samples provided by Jim Anton. Our evidence will show that in a fit of rage over the card game, Jim Anton returned and

killed Darren Williams after their argument. As such, it is your duty to find him guilty of murder.

Defense's Opening Statement

Jim Anton did not kill his old time friend, Darren Williams. Not only were the two men best friends, they were like brothers. And like brothers sometimes do, Jim and Darren got mad at each other over a card game bet.

Witnesses, including Jim Anton himself, will testify regarding how close Jim and Darren were and how they often got into verbal arguments but were quick to forgive each other and move on. You will also hear from another witness who will testify that on the night of the murder and in the same neighbourhood where it occurred, she was out walking her dog and was approached by a strange man asking if she had any spare change.

Indeed, Darren was killed by the stab wounds he suffered to the chest and yes, some blood samples were found near the wounds. Even if the DNA in these blood samples did match Jim Anton's DNA, this is not enough evidence to conclude that Jim committed the murder. In fact, given that Darren was over at Jim's place that evening and that he had a nosebleed, it is not surprising that some of Jim's blood was found on Darren. This does not make Jim Anton a murderer, only someone who happened to shed blood due to a nosebleed. You will also hear that the murder weapon was never found and that Jim Anton never owned a machete.

Darren Williams' murder is beyond doubt a tragedy. What is even more tragic is that the true perpetrator of the crime is still somewhere out there, perhaps waiting to strike again. The prosecution will not be able to determine that Jim Anton was

responsible for his best friend's death. Therefore, you must find Jim Anton not guilty of murder.

Crown's First Witness: Constable Dirk McHugh

On Direct Examination by the Crown, Constable McHugh testified that:

- on the night of November 29, 2004, he and Sergeant Kealy took pictures of the crime scene and of Jim Anton's house
- the crime scene was located approximately 2 kilometres from Jim Anton's house and that the estimated time of the murder was approximately 8:20pm

CROWN AND MCHUGH GO THROUGH PICTURES AND EXHIBITS:

- photographs show Jim Anton's dining room table with empty soda cans, a deck of cards, and two of four chairs knocked over
- photograph of Jim's front hallway shows a door knob impression in the wall and a splintered door hinge
- photograph of Jim's front yard shows scuffle marks in the grass and spit on the driveway
- photograph of Darren Williams' body with blood stains and 4 stab wounds to the chest
- photograph showing positioning of the body and the condition of the deceased's fingernails as consistent with the victim struggling with his assailant before being stabbed in the chest

Exhibit 1: - photograph of two blood samples obtained from the crime scene NOT belonging to the victim himself

Exhibit 2: - photograph of two blood samples obtained from Jim Anton

Exhibit 3: - close-up photograph of the victim's stab wounds
- entry marks consistent with marks left by a machete knife

When Cross Examined by the Defense, Constable McHugh testified that:

- it was unclear whether or not the door knob impression and splintered door hinge had occurred the night of the murder
- there were blood stains at the bottom of Jim Anton's front steps
- that Jim Anton originally refused to give a blood sample, therefore the blood samples had to be obtained through court order
- the machete knife used in the stabbing has not been located

Crown's Second Witness: Rosa Scove

On Direct Examination by the Crown, Rosa Scove testified that:

- she is Jim Anton's next door neighbour and has been so for the past 6 years
- on the evening of November 29, 2004 at about 7:30pm, she heard a commotion coming from inside Jim's house. It sounded as though two men were screaming at each other
- she heard a banging that sounded like Jim's front door and from her living room window she saw Jim and two other men exit Jim's house.
- she opened her window slightly to hear what was going on and she heard Jim and one of the other men arguing over money
- she heard Jim say to the man, "If you don't pay me, I'm going to kill you." and the two men were getting into each other's faces
- she saw the third man get between the two who were fighting in order to break them up
- she saw the eventual victim walk away from the house and head down the street while Jim and the man who tried to break Jim and Darren up went back into Jim's house
- she had on two separate occasions witnessed Jim punch another man on his front lawn after an argument

When Cross Examined by the Defense, Rosa Scove testified that:

- on one of the occasions when she witnessed Jim punch another man, the man had hit Jim first
- she was not wearing her eyeglasses when she watched through her window
- she has on several occasions asked Jim to watch her house for her while she has been away on vacation

Crown's Third Witness: Ronald Fillmore

On Direct Examination by the Crown, Ronald Fillmore testified that:

- he had been friends with both Jim and Darren for over 10 years
- he had been playing cards at Jim's house the night of the murder
- he, Jim, Darren, and a fourth friend had been playing poker and betting on the games
- Jim was having a lucky night and winning a lot of the games
- Darren kept thinking he would win and kept betting on new games until he owed Jim one thousand dollars
- Jim asked Darren to write him a cheque for the one thousand dollars
- Darren said he would not write the cheque and that he had no intention of ever paying Jim
- Jim jumped out of his chair, knocking it over, and went right up to Darren's face and started screaming at him to pay up
- Darren told Jim he was out of control and said he was leaving
- Jim followed Darren out of the house, yelling and swearing at him and spitting on the ground. As he walked out, Jim tripped on the stairs, fell down, and his nose began to bleed. He said to Darren, "If you don't pay me, I'm going to kill you."
- Jim and Darren were getting in each other's faces, so he stepped between the two of them to break up the fight
- Darren walked away by himself down the street
- he and Jim went back into Jim's house
- he told Jim he was out of line with how he reacted and what he said to Darren
- he left Jim's house at about 7:50pm, about 10 minutes after Darren had walked away

When Cross Examined by the Defense, Ronald Fillmore testified that:

- in the past, Jim had threatened to kill him when he got really mad but had never followed through on the threats
- after Darren had left and he (Ronald) and Jim went back into Jim's house, Jim acknowledged that he had been inappropriate with Darren and said he would call him first thing in the morning to apologize
- Jim said he was going to call it an early night and go to bed

Crown's Fourth Witness: Dr. Eileen Schumann

On Direct Examination by the Crown, Dr. Schumann testified that:

- she is a forensic scientist who specializes in DNA evidence with publications in numerous journals and presentations at several professional conferences
- she is the lead forensic scientist at the Avery DNA laboratory located in Ottawa, Ontario, and has been working there for over 15 years
- she has been qualified as an expert witness in DNA analysis and population genetics by other courts over 20 times
- forensic DNA science is a branch of science concerned with the identification of individuals who match DNA profiles found at a particular place such as a crime scene
- population genetics is the branch of science in which statistics that explain the frequency with which a particular DNA pattern appears in a given population are studied and analyzed
- the guidelines for proper collection of DNA evidence include:
 - o proper training to specialized forensic police officers in the areas of collection, preservation, and packaging of DNA evidence
 - o officers taking precautions such as wearing gloves and facemasks to minimize their exposure to infectious agents, as well as to preclude transfer of their own DNA to evidence
 - o separate packaging of samples from different crime scenes as well as crime scene samples and comparison samples from persons of interest
 - o where relevant, items should be handled and packaged in a manner that preserves trace evidence such as hair, fibre, paint, soil, or gunshot residue
 - o for every evidence item collected, the officer should note who collected the item, the date, the location, and a brief item description
 - o item packaging should be properly labeled and closed to protect the items from extraneous substances, as well as from unauthorized access
 - o it is vitally important to protect evidence from exposure to heat and moisture, both of which have deleterious effects on DNA
 - o wet items require passive air-drying prior to packaging
 - o to maintain continuity of evidence items and therefore admissibility in Court, items should be uniquely labeled, properly packaged, and each transfer of the item should be documented

- she was asked to examine DNA evidence in the form of blood samples that were found on Darren Williams' body the night he was murdered along with blood samples obtained through court order from the defendant, Jim Anton
- to her knowledge, all the proper guidelines and procedures for the collection and analysis of DNA evidence had been followed
- the DNA test results showed a match between Jim Anton's blood samples and those found on the victim's body

On Cross Examination by the Defense, Dr. Schumann testified that:

- there are two types of errors (false positives) that can occur with DNA evidence
- a Random Match Error is the probability of a match being declared due to random chance
- a Lab Error Rate is the probability that a match report was declared due to a human error that occurred in the DNA lab
- the probability of either a Random Match or Lab Error for the current DNA evidence was about 1 in one billion
- except for the blood samples, no other DNA evidence was submitted for analysis

End of Crown's Case

Defense's First Witness: Jim Anton

On Direct Examination by the Defense, Jim Anton testified that:

- he and Darren Williams had been best friends since they met at university 12 years ago and that Darren was like a brother to him
- he had invited Darren and two other friends to play cards at his place on the night of November 29, 2004
- everyone was betting for money on the poker games they played
- Darren lost one thousand dollars to him but that when he went to collect the money, Darren refused to pay
- he got angry and started yelling at Darren to get him to pay up
- that the argument continued in his front yard and that he got so angry at Darren that he said to him, "If you don't pay me, I'm going to kill you" but that he said this without thinking and that he had no intention of following through on the threat
- that on his way into the front yard, he tripped and fell and as a result, his nose started to bleed
- after Darren walked away and he (Jim) had calmed down, he felt extremely bad about what he had said and how he had acted toward Darren and that he planned to call Darren in the morning to apologize
- he did not currently own nor had he ever owned a machete
- he did not kill Darren Williams

When Cross Examined by the Crown, Jim Anton testified that:

- at approximately 8:00pm on the night of the murder, he left his house to go to the corner store to get some milk
- the store he went to was in the opposite direction from where Darren's body was found
- he had the tendency to "blow up" easily when he was mad about something
- he had on 2-3 occasions in the past five years been so angry that he got into a fist fight with various male friends

Defense's Second Witness: Elliot Sampson

On Direct Examination by the Defense, Elliot Sampson testified that:

- he was the fourth person who had been playing cards at Jim Anton's house the night of the murder
- he had been friends with both Jim and Darren for over 10 years
- on the night of the murder, he had left Jim's house at approximately 6:45pm before Jim and Darren had started fighting
- when he left, Jim and Darren were laughing and talking about the last poker hand they had played
- he had witnessed Jim and Darren get into many fights and arguments over the years but that they always forgave each other and stayed best friends
- in the context of these past fights and arguments, he had heard Jim and Darren say things such as "I'm going to kill you" to each other but that neither had ever followed through on the threats
- to his knowledge, Jim had never owned a knife or any kind of weapon

When Cross Examined by the Crown, Elliot Sampson testified that:

- Jim had once told him that he would love to get a machete one day
- Jim had recently told him that he was afraid he would not have enough money to pay his mortgage that month and that this would be the second month in a row
- Jim said the bank had allowed him to pay late last month but warned him not to let it happen again
- Jim said he would do anything to get his hands on some extra money

Defense's Third Witness: Anna Goldstein

On Direct Examination by the Defense, Anna Goldstein testified that:

- that she lived a block away from where Darren's body was found
- she did not know Jim Anton personally, but that she had seen him around the neighbourhood on different occasions
- that she was out walking her dog between 7:00 and 7:30pm on the night of the murder
- that during her walk, a strange man whom she had never seen before approached her and asked if she had any money to spare
- that the man seemed nervous and kept looking around him and that he was probably in his mid-40's, about 5'11" tall, weighing approximately 175lbs, with brown hair and brown eyes
- that she told the man she had no money for him
- that after she told him this, he frowned and looked as though he was going to take a step closer to her
- that her dog barked and growled as the man started to move and that he immediately backed up and walked away
- that this incident was somewhat frightening to her and that she considered calling the police right away but decided not to because she thought maybe she was overreacting
- that after she heard about Darren's murder the next day, she immediately thought of the strange man and decided at that point to call the police

When Cross Examined by the Crown, Anna Goldstein testified that:

- the man could have been someone who lived in the neighbourhood who she had never seen before
- the man never verbally threatened her in any way
- that the man did not give any indication that he was carrying a weapon on him
- that she could not tell where the man was headed after her encounter with him

End of Defense's Case

Judge's Instructions

Members of the jury, I will now instruct you as to the laws that apply to this case. The law is intended to be helpful to you in reaching a just and proper verdict in the case, however, it is not binding upon you as members of the jury and you may accept or reject it as you feel is appropriate to the case at hand.

The charge against Jim Anton is murder in the first degree. When dealing with a charge you must be satisfied that each element of the verdict has been proven by the Crown. For a finding of murder in the first degree, the intent to cause the death or bodily harm likely to cause death had to have been planned and deliberate by the accused. The presumption of innocence is in the accused's favour and the burden of proving him guilty beyond a reasonable doubt is on the Crown. You must decide whether Jim Anton is guilty or not guilty of murder in the first degree.

While you must give respectful attention to the laws, you have the final authority to decide whether or not to apply a given law to the acts of the defendant on trial. You, the jurors, represent the community and it is appropriate to bring into your decision, both the feelings of the community, and your own feelings based on your conscience. Despite your respect for the law, nothing would bar you from acquitting the defendant if you feel that the law, as applied to the situation before you, would produce an inequitable or unjust verdict.

Appendix D (Weak DNA)

Thank you for agreeing to take part in this research.

On the following pages is a summary of a trial transcript. Please read the transcript and try to imagine yourself as a juror faced with this evidence. Once you have read through the trial, you will be asked to answer some questions.

Please treat this as an independent exercise. We are interested in your opinions and therefore it is very important for the purposes of the research that you refrain from discussing the case with other people who may be participating in this study.

Judge's Instructions

Jim Anton has been charged with the crime of murder in the first degree. The Crown has the burden of proving that charge beyond a reasonable doubt. It is your duty to read all of the evidence, to decide the facts, and then to apply the law that I give you at the end of the trial.

The case will begin with opening statements from the prosecution and the defense attorneys. Each will tell you what they expect to prove. These statements are not evidence, they are only a summary to help you follow the case.

The prosecution will then call witnesses for the Crown. After the prosecution has finished questioning a witness, counsel for the accused will be allowed to question the same witness. After all the witnesses for the prosecution have been heard, the accused's attorney may choose to present witnesses on the accused's behalf.

Prosecution's Opening Statement

Darren Williams (deceased) and Jim Anton (accused) were friends aged 31 and 34 years old, respectively who lived in the city of Toronto. They met several years ago when they were both studying together at the University of Toronto.

Witnesses will testify regarding the events that transpired the evening of the killing. On this night, Jim, Darren, and two other male friends played cards at Jim's house. The men decided to place monetary bets on their card games, and by the end of the evening, Darren owed Jim one thousand dollars. Jim asked to collect the money that Darren owed him, but Darren refused to pay. Darren went to leave Jim's house, and Jim followed him outside where an argument over the money ensued between the two men. The two men walked away from each other after the argument and Jim was still extremely angry. About a half hour after they walked away from each other, the victim, Darren Williams, was found dead on the side of the road.

Witnesses will testify that Jim had been heard not only making death threats towards Darren, but that Jim has a history of verbal and physical violence towards others. Two witnesses will testify that on the night of the murder, Jim said to Darren, "If you don't pay up, I'm going to kill you."

Forensic examinations revealed that Darren Williams was killed by multiple stab wounds to the chest inflicted by a machete. Blood samples were found on Darren William's body near his stab wounds and you'll hear from an expert witness that the DNA in those blood samples matched the DNA in blood samples provided by Jim Anton. Our evidence will show that in a fit of rage over the card game, Jim Anton returned and

killed Darren Williams after their argument. As such, it is your duty to find him guilty of murder.

Defense's Opening Statement

Jim Anton did not kill his old time friend, Darren Williams. Not only were the two men best friends, they were like brothers. And like brothers sometimes do, Jim and Darren got mad at each other over a card game bet.

Witnesses, including Jim Anton himself, will testify regarding how close Jim and Darren were and how they often got into verbal arguments but were quick to forgive each other and move on. You will also hear from another witness who will testify that on the night of the murder and in the same neighbourhood where it occurred, she was out walking her dog and was approached by a strange man asking if she had any spare change.

Indeed, Darren was killed by the stab wounds he suffered to the chest and yes, some blood samples were found near the wounds. Even if the DNA in these blood samples did match Jim Anton's DNA, this is not enough evidence to conclude that Jim committed the murder. In fact, given that Darren was over at Jim's place that evening and that he had a nosebleed, it is not surprising that Jim's blood was found on Darren. This does not make Jim Anton a murderer, only someone who happened to shed blood due to a nosebleed. You will also hear that the murder weapon was never found and that Jim Anton never owned a machete.

Darren Williams' murder is beyond doubt a tragedy. What is even more tragic is that the true perpetrator of the crime is still somewhere out there, perhaps waiting to strike again. The prosecution will not be able to demonstrate that Jim Anton was

responsible for his best friend's death. Therefore, you must find Jim Anton not guilty of murder.

Crown's First Witness: Constable Dirk McHugh

On Direct Examination by the Crown, Constable McHugh testified that:

- on the night of November 29, 2004, he and Sergeant Kealy took pictures of the crime scene and of Jim Anton's house
- the crime scene was located approximately 2 kilometres from Jim Anton's house and that the estimated time of the murder was approximately 8:20pm

CROWN AND MCHUGH GO THROUGH PICTURES AND EXHIBITS:

- photographs show Jim Anton's dining room table with empty soda cans, a deck of cards, and two of four chairs knocked over
- photograph of Jim's front hallway shows a door knob impression in the wall and a splintered door hinge
- photograph of Jim's front yard shows scuffle marks in the grass and spit on the driveway
- photograph of Darren Williams' body with blood stains and 4 stab wounds to the chest
- photograph showing positioning of the body and the condition of the deceased's fingernails as consistent with the victim struggling with his assailant before being stabbed in the chest

Exhibit 1: - photograph of two blood samples obtained from the crime scene NOT belonging to the victim himself

Exhibit 2: - photograph of two blood samples obtained from Jim Anton

Exhibit 3: - close-up photograph of the victim's stab wounds
- entry marks consistent with marks left by a machete knife

When Cross Examined by the Defense, Constable McHugh testified that:

- it was unclear whether or not the door knob impression and splintered door hinge had occurred the night of the murder
- there were blood stains at the bottom of Jim Anton's front steps
- that Jim Anton willingly gave a sample of his own blood
- the machete knife used in the stabbing has not been located

Crown's Second Witness: Rosa Scove

On Direct Examination by the Crown, Rosa Scove testified that:

- she is Jim Anton's next door neighbour and has been so for the past 6 years
- on the evening of November 29, 2004 at about 7:30pm, she heard a commotion coming from inside Jim's house. It sounded as though two men were screaming at each other
- she heard a banging that sounded like Jim's front door and from her living room window she saw Jim and two other men exit Jim's house.
- she opened her window slightly to hear what was going on and she heard Jim and one of the other men arguing over money
- she heard Jim say to the man, "If you don't pay me, I'm going to kill you." and the two men were getting into each other's faces
- she saw the third man get between the two who were fighting in order to break them up
- she saw the eventual victim walk away from the house and head down the street while Jim and the man who tried to break Jim and Darren up went back into Jim's house
- she had on two separate occasions witnessed Jim punch another man on his front lawn after an argument

When Cross Examined by the Defense, Rosa Scove testified that:

- on one of the occasions when she witnessed Jim punch another man, the man had hit Jim first
- she was not wearing her eyeglasses when she watched through her window
- she has on several occasions asked Jim to watch her house for her while she has been away on vacation

Crown's Third Witness: Ronald Fillmore

On Direct Examination by the Crown, Ronald Fillmore testified that:

- he had been friends with both Jim and Darren for over 10 years
- he had been playing cards at Jim's house the night of the murder
- he, Jim, Darren, and a fourth friend had been playing poker and betting on the games
- Jim was having a lucky night and winning a lot of the games
- Darren kept thinking he would win and kept betting on new games until he owed Jim one thousand dollars
- Jim asked Darren to write him a cheque for the one thousand dollars
- Darren said he would not write the cheque and that he had no intention of ever paying Jim
- Jim jumped out of his chair, knocking it over, and went right up to Darren's face and started screaming at him to pay up
- Darren told Jim he was out of control and said he was leaving
- Jim followed Darren out of the house, yelling and swearing at him and spitting on the ground. As he walked out, Jim tripped on the stairs, fell down, and his nose began to bleed. He said to Darren, "If you don't pay me, I'm going to kill you."
- Jim and Darren were getting in each other's faces, so he stepped between the two of them to break up the fight
- Darren walked away by himself down the street
- he and Jim went back into Jim's house
- he told Jim he was out of line with how he reacted and what he said to Darren
- he left Jim's house at about 7:50pm, about 10 minutes after Darren had walked away

When Cross Examined by the Defense, Ronald Fillmore testified that:

- in the past, Jim had threatened to kill him when he got really mad but had never followed through on the threats
- after Darren had left and he (Ronald) and Jim went back into Jim's house, Jim acknowledged that he had been inappropriate with Darren and said he would call him first thing in the morning to apologize
- Jim said he was going to call it an early night and go to bed

Crown's Fourth Witness: Dr. Eileen Schumann

On Direct Examination by the Crown, Dr. Schumann testified that:

- she is a forensic scientist who specializes in DNA evidence with publications in numerous journals and presentations at several professional conferences
- she is the lead forensic scientist at the Avery DNA laboratory located in Ottawa, Ontario, and has been working there for over 15 years
- she has been qualified as an expert witness in DNA analysis and population genetics by other courts over 20 times
- forensic DNA science is a branch of science concerned with the identification of individuals who match DNA profiles found at a particular place such as a crime scene
- population genetics is the branch of science in which statistics that explain the frequency with which a particular DNA pattern appears in a given population are studied and analyzed
- the guidelines for proper collection of DNA evidence include:
 - o proper training to specialized forensic police officers in the areas of collection, preservation, and packaging of DNA evidence
 - o officers taking precautions such as wearing gloves and facemasks to minimize their exposure to infectious agents, as well as to preclude transfer of their own DNA to evidence
 - o separate packaging of samples from different crime scenes as well as crime scene samples and comparison samples from persons of interest
 - o where relevant, items should be handled and packaged in a manner that preserves trace evidence such as hair, fibre, paint, soil, or gunshot residue
 - o for every evidence item collected, the officer should note who collected the item, the date, the location, and a brief item description
 - o item packaging should be properly labeled and closed to protect the items from extraneous substances, as well as from unauthorized access
 - o it is vitally important to protect evidence from exposure to heat and moisture, both of which have deleterious effects on DNA
 - o wet items require passive air-drying prior to packaging
 - o to maintain continuity of evidence items and therefore admissibility in Court, items should be uniquely labeled, properly packaged, and each transfer of the item should be documented

- she was asked to examine DNA evidence in the form of blood samples that were found on Darren Williams' body the night he was murdered along with blood samples obtained willingly from the defendant, Jim Anton
- to her knowledge, all the proper guidelines and procedures for the collection and analysis of DNA evidence had been followed
- the DNA test results showed a match between Jim Anton's blood samples and those found on the victim's body

On Cross Examination by the Defense, Dr. Schumann testified that:

- there are two types of errors (false positives) that can occur with DNA evidence
- a Random Match Error is the probability of a match being declared due to random chance
- a Lab Error Rate is the probability that a match report was declared due to a human error that occurred in the DNA lab
- the probability of either a Random Match or Lab Error for the current DNA evidence was about 1 in 50
- except for the blood samples, no other DNA evidence was submitted for analysis

End of Crown's Case

Defense's First Witness: Jim Anton

On Direct Examination by the Defense, Jim Anton testified that:

- he and Darren Williams had been best friends since they met at university 12 years ago and that Darren was like a brother to him
- he had invited Darren and two other friends to play cards at his place on the night of November 29, 2004
- everyone was betting for money on the poker games they played
- Darren lost one thousand dollars to him but that when he went to collect the money, Darren refused to pay
- he got angry and started yelling at Darren to get him to pay up
- that the argument continued in his front yard and that he got so angry at Darren that he said to him, "If you don't pay me, I'm going to kill you" but that he said this without thinking and that he had no intention of following through on the threat
- that on his way into the front yard, he tripped and fell and as a result, his nose started to bleed
- after Darren walked away and he (Jim) had calmed down, he felt extremely bad about what he had said and how he had acted toward Darren and that he planned to call Darren in the morning to apologize
- he did not currently own nor had he ever owned a machete
- he did not kill Darren Williams

When Cross Examined by the Crown, Jim Anton testified that:

- at approximately 8:00pm on the night of the murder, he left his house to go to the corner store to get some milk
- the store he went to was in the opposite direction from where Darren's body was found
- he had the tendency to "blow up" easily when he was mad about something
- he had on 2-3 occasions in the past five years been so angry that he got into a fist fight with various male friends

Defense's Second Witness: Elliot Sampson

On Direct Examination by the Defense, Elliot Sampson testified that:

- he was the fourth person who had been playing cards at Jim Anton's house the night of the murder
- he had been friends with both Jim and Darren for over 10 years
- on the night of the murder, he had left Jim's house at approximately 6:45pm before Jim and Darren had started fighting
- when he left, Jim and Darren were laughing and talking about the last poker hand they had played
- he had witnessed Jim and Darren get into many fights and arguments over the years but that they always forgave each other and stayed best friends
- in the context of these past fights and arguments, he had heard Jim and Darren say things such as "I'm going to kill you" to each other but that neither had ever followed through on the threats
- to his knowledge, Jim had never owned a knife or any kind of weapon

When Cross Examined by the Crown, Elliot Sampson testified that:

- Jim had once told him that he would love to get a machete one day
- Jim had recently told him that he was afraid he would not have enough money to pay his mortgage that month and that this would be the second month in a row
- Jim said the bank had allowed him to pay late last month but warned him not to let it happen again
- Jim said he would do anything to get his hands on some extra money

Defense's Third Witness: Anna Goldstein

On Direct Examination by the Defense, Anna Goldstein testified that:

- that she lived a block away from where Darren's body was found
- she did not know Jim Anton personally, but that she had seen him around the neighbourhood on different occasions
- that she was out walking her dog between 7:00 and 7:30pm on the night of the murder
- that during her walk, a strange man whom she had never seen before approached her and asked if she had any money to spare
- that the man seemed nervous and kept looking around him and that he was probably in his mid-40's, about 5'11" tall, weighing approximately 175lbs, with brown hair and brown eyes
- that she told the man she had no money for him
- that after she told him this, he frowned and looked as though he was going to take a step closer to her
- that her dog barked and growled as the man started to move and that he immediately backed up and walked away
- that this incident was somewhat frightening to her and that she considered calling the police right away but decided not to because she thought maybe she was overreacting
- that after she heard about Darren's murder the next day, she immediately thought of the strange man and decided at that point to call the police

When Cross Examined by the Crown, Anna Goldstein testified that:

- the man could have been someone who lived in the neighbourhood who she had never seen before
- the man never verbally threatened her in any way
- that the man did not give any indication that he was carrying a weapon on him
- that she could not tell where the man was headed after her encounter with him

End of Defense's Case

Judge's Instructions

Members of the jury, I will now instruct you as to the laws that apply to this case. The law is intended to be helpful to you in reaching a just and proper verdict in the case, however, it is not binding upon you as members of the jury and you may accept or reject it as you feel is appropriate to the case at hand.

The charge against Jim Anton is murder in the first degree. When dealing with a charge you must be satisfied that each element of the verdict has been proven by the Crown. For a finding of murder in the first degree, the intent to cause the death or bodily harm likely to cause death had to have been planned and deliberate by the accused. The presumption of innocence is in the accused's favour and the burden of proving him guilty beyond a reasonable doubt is on the Crown. You must decide whether Jim Anton is guilty or not guilty of murder in the first degree.

While you must give respectful attention to the laws, you have the final authority to decide whether or not to apply a given law to the acts of the defendant on trial. You, the jurors, represent the community and it is appropriate to bring into your decision, both the feelings of the community, and your own feelings based on your conscience. Despite your respect for the law, nothing would bar you from acquitting the defendant if you feel that the law, as applied to the situation before you, would produce an inequitable or unjust verdict.

Appendix E (Ambiguous DNA)

Thank you for agreeing to take part in this research.

On the following pages is a summary of a trial transcript. Please read the transcript and try to imagine yourself as a juror faced with this evidence. Once you have read through the trial, you will be asked to answer some questions.

Please treat this as an independent exercise. We are interested in your opinions and therefore it is very important for the purposes of the research that you refrain from discussing the case with other people who may be participating in this study.

Judge's Instructions

Jim Anton has been charged with the crime of murder in the first degree. The Crown has the burden of proving that charge beyond a reasonable doubt. It is your duty to read all of the evidence, to decide the facts, and then to apply the law that I give you at the end of the trial.

The case will begin with opening statements from the prosecution and the defense attorneys. Each will tell you what they expect to prove. These statements are not evidence, they are only a summary to help you follow the case.

The prosecution will then call witnesses for the Crown. After the prosecution has finished questioning a witness, counsel for the accused will be allowed to question the same witness. After all the witnesses for the prosecution have been heard, the accused's attorney may choose to present witnesses on the accused's behalf.

Prosecution's Opening Statement

Darren Williams (deceased) and Jim Anton (accused) were friends aged 31 and 34 years old, respectively who lived in the city of Toronto. They met several years ago when they were both studying together at the University of Toronto.

Witnesses will testify regarding the events that transpired the evening of the killing. On this night, Jim, Darren, and two other male friends played cards at Jim's house. The men decided to place monetary bets on their card games, and by the end of the evening, Darren owed Jim one thousand dollars. Jim asked to collect the money that Darren owed him, but Darren refused to pay. Darren went to leave Jim's house, and Jim followed him outside where an argument over the money ensued between the two men. The two men walked away from each other after the argument and Jim was still extremely angry. About a half hour after they walked away from each other, the victim, Darren Williams, was found dead on the side of the road.

Witnesses will testify that Jim had been heard not only making death threats towards Darren, but that Jim has a history of verbal and physical violence towards others. Two witnesses will testify that on the night of the murder, Jim said to Darren, "If you don't pay up, I'm going to kill you."

Forensic examinations revealed that Darren Williams was killed by multiple stab wounds to the chest inflicted by a machete. Blood samples were found on Darren William's body near his stab wounds and you'll hear from an expert witness that the DNA in those blood samples matched the DNA in blood samples provided by Jim Anton. Our evidence will show that in a fit of rage over the card game, Jim Anton returned and

killed Darren Williams after their argument. As such, it is your duty to find him guilty of murder.

Defense's Opening Statement

Jim Anton did not kill his old time friend, Darren Williams. Not only were the two men best friends, they were like brothers. And like brothers sometimes do, Jim and Darren got mad at each other over a card game bet.

Witnesses, including Jim Anton himself, will testify regarding how close Jim and Darren were and how they often got into verbal arguments but were quick to forgive each other and move on. You will also hear from another witness who will testify that on the night of the murder and in the same neighbourhood where it occurred, she was out walking her dog and was approached by a strange man asking if she had any change.

Indeed, Darren was killed by the stab wounds he suffered to the chest and yes, some blood samples were found near the wounds. Even if the DNA in these blood samples did match Jim Anton's DNA, this is not enough evidence to conclude that Jim committed the murder. You will hear from a second expert witness that during the analysis of the blood, contamination of the samples may have taken place and that the Crown's results may not be accurate. In fact, given that Darren was over at Jim's place that evening and that he had a nosebleed, it is not surprising that Jim's blood was found on Darren. This does not make Jim Anton a murderer, only someone who happened to shed blood due to a nosebleed. You will also hear that the murder weapon was never found and that Jim Anton never owned a machete.

Darren Williams' murder is beyond doubt a tragedy. What is even more tragic is that the true perpetrator of the crime is still somewhere out there, perhaps waiting to strike again. The prosecution will not be able to demonstrate that Jim Anton was

responsible for his best friend's death. Therefore, you must find Jim Anton not guilty of murder.

Crown's First Witness: Constable Dirk McHugh

On Direct Examination by the Crown, Constable McHugh testified that:

- on the night of November 29, 2004, he and Sergeant Kealy took pictures of the crime scene and of Jim Anton's house
- the crime scene was located approximately 2 kilometres from Jim Anton's house and that the estimated time of the murder was approximately 8:20pm

CROWN AND MCHUGH GO THROUGH PICTURES AND EXHIBITS:

- photographs show Jim Anton's dining room table with empty soda cans, a deck of cards, and two of four chairs knocked over
- photograph of Jim's front hallway shows a door knob impression in the wall and a splintered door hinge
- photograph of Jim's front yard shows scuffle marks in the grass and spit on the driveway
- photograph of Darren Williams' body with blood stains and 4 stab wounds to the chest
- photograph showing positioning of the body and the condition of the deceased's fingernails as consistent with the victim struggling with his assailant before being stabbed in the chest

Exhibit 1: - photograph of two blood samples obtained from the crime scene NOT belonging to the victim himself

Exhibit 2: - photograph of two blood samples obtained from Jim Anton

Exhibit 3: - close-up photograph of the victim's stab wounds
- entry marks consistent with marks left by a machete knife

When Cross Examined by the Defense, Constable McHugh testified that:

- it was unclear whether or not the door knob impression and splintered door hinge had occurred the night of the murder
- there were blood stains at the bottom of Jim Anton's front steps
- that Jim Anton was somewhat reluctant to give a sample of his blood, but ultimately ended up doing so
- the machete knife used in the stabbing has not been located

Crown's Second Witness: Rosa Scove

On Direct Examination by the Crown, Rosa Scove testified that:

- she is Jim Anton's next door neighbour and has been so for the past 6 years
- on the evening of November 29, 2004 at about 7:30pm, she heard a commotion coming from inside Jim's house. It sounded as though two men were screaming at each other
- she heard a banging that sounded like Jim's front door and from her living room window she saw Jim and two other men exit Jim's house.
- she opened her window slightly to hear what was going on and she heard Jim and one of the other men arguing over money
- she heard Jim say to the man, "If you don't pay me, I'm going to kill you." and the two men were getting into each other's faces
- she saw the third man get between the two who were fighting in order to break them up
- she saw the eventual victim walk away from the house and head down the street while Jim and the man who tried to break Jim and Darren up went back into Jim's house
- she had on two separate occasions witnessed Jim punch another man on his front lawn after an argument

When Cross Examined by the Defense, Rosa Scove testified that:

- on one of the occasions when she witnessed Jim punch another man, the man had hit Jim first
- she was not wearing her eyeglasses when she watched through her window
- she has on several occasions asked Jim to watch her house for her while she has been away on vacation

Crown's Third Witness: Ronald Fillmore

On Direct Examination by the Crown, Ronald Fillmore testified that:

- he had been friends with both Jim and Darren for over 10 years
- he had been playing cards at Jim's house the night of the murder
- he, Jim, Darren, and a fourth friend had been playing poker and betting on the games
- Jim was having a lucky night and winning a lot of the games
- Darren kept thinking he would win and kept betting on new games until he owed Jim one thousand dollars
- Jim asked Darren to write him a cheque for the one thousand dollars
- Darren said he would not write the cheque and that he had no intention of ever paying Jim
- Jim jumped out of his chair, knocking it over, and went right up to Darren's face and started screaming at him to pay up
- Darren told Jim he was out of control and said he was leaving
- Jim followed Darren out of the house, yelling and swearing at him and spitting on the ground. As he walked out, Jim tripped on the stairs, fell down, and his nose began to bleed. He said to Darren, "If you don't pay me, I'm going to kill you."
- Jim and Darren were getting in each other's faces, so he stepped between the two of them to break up the fight
- Darren walked away by himself down the street
- he and Jim went back into Jim's house
- he told Jim he was out of line with how he reacted and what he said to Darren
- he left Jim's house at about 7:50pm, about 10 minutes after Darren had walked away

When Cross Examined by the Defense, Ronald Fillmore testified that:

- in the past, Jim had threatened to kill him when he got really mad but had never followed through on the threats
- after Darren had left and he (Ronald) and Jim went back into Jim's house, Jim acknowledged that he had been inappropriate with Darren and said he would call him first thing in the morning to apologize
- Jim said he was going to call it an early night and go to bed

Crown's Fourth Witness: Dr. Eileen Schumann

On Direct Examination by the Crown, Dr. Schumann testified that:

- she is a forensic scientist who specializes in DNA evidence with publications in numerous journals and presentations at several professional conferences
- she is the lead forensic scientist at the Avery DNA laboratory located in Ottawa, Ontario, and has been working there for over 15 years
- she has been qualified as an expert witness in DNA analysis and population genetics by other courts over 20 times
- forensic DNA science is a branch of science concerned with the identification of individuals who match DNA profiles found at a particular place such as a crime scene
- population genetics is the branch of science in which statistics that explain the frequency with which a particular DNA pattern appears in a given population are studied and analyzed
- the guidelines for proper collection of DNA evidence include:
 - o proper training to specialized forensic police officers in the areas of collection, preservation, and packaging of DNA evidence
 - o officers taking precautions such as wearing gloves and facemasks to minimize their exposure to infectious agents, as well as to preclude transfer of their own DNA to evidence
 - o separate packaging of samples from different crime scenes as well as crime scene samples and comparison samples from persons of interest
 - o where relevant, items should be handled and packaged in a manner that preserves trace evidence such as hair, fibre, paint, soil, or gunshot residue
 - o for every evidence item collected, the officer should note who collected the item, the date, the location, and a brief item description
 - o item packaging should be properly labeled and closed to protect the items from extraneous substances, as well as from unauthorized access
 - o it is vitally important to protect evidence from exposure to heat and moisture, both of which have deleterious effects on DNA
 - o wet items require passive air-drying prior to packaging
 - o to maintain continuity of evidence items and therefore admissibility in Court, items should be uniquely labeled, properly packaged, and each transfer of the item should be documented

- she was asked to examine DNA evidence in the form of blood samples that were found on Darren Williams' body the night he was murdered along with blood samples obtained with some reluctance from the defendant, Jim Anton
- to her knowledge, all the proper guidelines and procedures for the collection and analysis of DNA evidence had been followed
- the DNA test results showed a match between Jim Anton's blood samples and those found on the victim's body

On Cross Examination by the Defense, Dr. Schumann testified that:

- there are two types of errors (false positives) that can occur with DNA evidence
- a Random Match Error is the probability of a match being declared due to random chance
- a Lab Error Rate is the probability that a match report was declared due to a human error that occurred in the DNA lab
- the probability of either a Random Match or Lab Error for the current DNA evidence was about 1 in one billion
- except for the blood samples, no other DNA evidence was submitted for analysis

End of Crown's Case

Defense's First Witness: Jim Anton

On Direct Examination by the Defense, Jim Anton testified that:

- he and Darren Williams had been best friends since they met at university 12 years ago and that Darren was like a brother to him
- he had invited Darren and two other friends to play cards at his place on the night of November 29, 2004
- everyone was betting for money on the poker games they played
- Darren lost one thousand dollars to him but that when he went to collect the money, Darren refused to pay
- he got angry and started yelling at Darren to get him to pay up
- that the argument continued in his front yard and that he got so angry at Darren that he said to him, "If you don't pay me, I'm going to kill you" but that he said this without thinking and that he had no intention of following through on the threat
- that on his way into the front yard, he tripped and fell and as a result, his nose started to bleed
- after Darren walked away and he (Jim) had calmed down, he felt extremely bad about what he had said and how he had acted toward Darren and that he planned to call Darren in the morning to apologize
- he did not currently own nor had he ever owned a machete
- he did not kill Darren Williams

When Cross Examined by the Crown, Jim Anton testified that:

- at approximately 8:00pm on the night of the murder, he left his house to go to the corner store to get some milk
- the store he went to was in the opposite direction from where Darren's body was found
- he had the tendency to "blow up" easily when he was mad about something
- he had on 2-3 occasions in the past five years been so angry that he got into a fist fight with various male friends

Defense's Second Witness: Elliot Sampson

On Direct Examination by the Defense, Elliot Sampson testified that:

- he was the fourth person who had been playing cards at Jim Anton's house the night of the murder
- he had been friends with both Jim and Darren for over 10 years
- on the night of the murder, he had left Jim's house at approximately 6:45pm before Jim and Darren had started fighting
- when he left, Jim and Darren were laughing and talking about the last poker hand they had played
- he had witnessed Jim and Darren get into many fights and arguments over the years but that they always forgave each other and stayed best friends
- in the context of these past fights and arguments, he had heard Jim and Darren say things such as "I'm going to kill you" to each other but that neither had ever followed through on the threats
- to his knowledge, Jim had never owned a knife or any kind of weapon

When Cross Examined by the Crown, Elliot Sampson testified that:

- Jim had once told him that he would love to get a machete one day
- Jim had recently told him that he was afraid he would not have enough money to pay his mortgage that month and that this would be the second month in a row
- Jim said the bank had allowed him to pay late last month but warned him not to let it happen again
- Jim said he would do anything to get his hands on some extra money

Defense's Third Witness: Anna Goldstein

On Direct Examination by the Defense, Anna Goldstein testified that:

- that she lived a block away from where Darren's body was found
- she did not know Jim Anton personally, but that she had seen him around the neighbourhood on different occasions
- that she was out walking her dog between 7:00 and 7:30pm on the night of the murder
- that during her walk, a strange man whom she had never seen before approached her and asked if she had any money to spare
- that the man seemed nervous and kept looking around him and that he was probably in his mid-40's, about 5'11" tall, weighing approximately 175lbs, with brown hair and brown eyes
- that she told the man she had no money for him
- that after she told him this, he frowned and looked as though he was going to take a step closer to her
- that her dog barked and growled as the man started to move and that he immediately backed up and walked away
- that this incident was somewhat frightening to her and that she considered calling the police right away but decided not to because she thought maybe she was overreacting
- that after she heard about Darren's murder the next day, she immediately thought of the strange man and decided at that point to call the police

When Cross Examined by the Crown, Anna Goldstein testified that:

- the man could have been someone who lived in the neighbourhood who she had never seen before
- the man never verbally threatened her in any way
- that the man did not give any indication that he was carrying a weapon on him
- that she could not tell where the man was headed after her encounter with him

Defense's Fourth Witness: Dr. Jane Covington

On Direct Examination by the Defense, Dr. Covington testified that:

- she is a forensic scientist who specializes in DNA evidence with publications in numerous journals and presentations at several professional conferences
- she is the lead forensic scientist at the Stanton DNA laboratory, located in Kitchener, Ontario, and has been working there for approximately 18 years
- she has been qualified as an expert witness in DNA analysis and population genetics by other courts over 25 times
- she was asked on behalf of the defense to be present while the blood samples found on Darren Williams' body and those obtained from Jim Anton were analyzed by Dr. Schumann and her team
- she observed one of the lab technicians sneeze while handling the blood samples and that she believed the DNA evidence may have been contaminated as a result
- given this possibility of contamination, the probability of either a Random Match or Lab Error for the current DNA evidence was about 1 in 50

On Cross Examination by the Defense, Dr. Covington testified that:

- the lab technician did attempt to turn away from his work when he sneezed
- the technician was wearing a face mask when he sneezed but that the mask was loose enough that mucous from the sneeze could have escaped

End of Defense's Case

Judge's Instructions

Members of the jury, I will now instruct you as to the laws that apply to this case. The law is intended to be helpful to you in reaching a just and proper verdict in the case, however, it is not binding upon you as members of the jury and you may accept or reject it as you feel is appropriate to the case at hand.

The charge against Jim Anton is murder in the first degree. When dealing with a charge you must be satisfied that each element of the verdict has been proven by the Crown. For a finding of murder in the first degree, the intent to cause the death or bodily harm likely to cause death had to have been planned and deliberate by the accused. The presumption of innocence is in the accused's favour and the burden of proving him guilty beyond a reasonable doubt is on the Crown. You must decide whether Jim Anton is guilty or not guilty of murder in the first degree.

While you must give respectful attention to the laws, you have the final authority to decide whether or not to apply a given law to the acts of the defendant on trial. You, the jurors, represent the community and it is appropriate to bring into your decision, both the feelings of the community, and your own feelings based on your conscience. Despite your respect for the law, nothing would bar you from acquitting the defendant if you feel that the law, as applied to the situation before you, would produce an inequitable or unjust verdict.

Appendix F

Based on the information you read, how strong do you feel the DNA evidence was against Jim Anton (the defendant)? Please decide on a number between 0 and 100 where:

0 = *Very Weak* and

100 = *Very Strong*

YOUR RATING (between 0 and 100): _____

Appendix G

Based on the information you read, how strong do you feel the prosecution's case was against Jim Anton (the defendant)? Please decide on a number between 0 and 100 where:

0 = *Very Weak* and

100 = *Very Strong*

YOUR RATING (between 0 and 100): _____

Appendix H

Based on the information you read, how strong do you feel the defense's case was in support of Jim Anton (the defendant) not being guilty? Please decide on a number between 0 and 100 where:

0 = *Very Weak* and

100 = *Very Strong*

YOUR RATING (between 0 and 100): _____

Appendix I

Based on the information you read, please rate the degree to which you think Jim Anton is guilty. To do so, please decide on a number between 0 and 100 where:

0 = *Definitely Not Guilty* and

100 = *Definitely Guilty*

YOUR RATING (between 0 and 100): _____

Appendix J

How confident are you that the verdict rating you just chose is correct? Please decide on a number between 0 and 100 where:

0 = *Not at all Confident* and

100 = *Extremely Confident*

YOUR RATING (between 0 and 100): _____

Appendix K

Based on the information you read, how credible (believable) do you find the expert witness (Dr. Schumann) was? Please decide on a number between 0 and 100 where:

0 = *Not at all credible* and

100 = *Extremely credible*

YOUR RATING (between 0 and 100): _____

Appendix L

Based on the information you read, how persuasive do you find the expert witness (Dr. Schumann) was? Please decide on a number between 0 and 100 where:

0 = *Not at all persuasive* and

100 = *Extremely persuasive*

YOUR RATING (between 0 and 100): _____

Appendix M

Based on the information you read, how useful did you find the expert witness' (Dr. Schumann) testimony was? Please decide on a number between 0 and 100 where:

0 = *Not at all useful* and

100 = *Extremely useful*

YOUR RATING (between 0 and 100): _____

Appendix N (Case Summary, Study 2)

Thank you for agreeing to take part in this research.

On the following pages is a summary of a trial transcript. Please read the transcript and try to imagine yourself as a juror faced with this evidence. Once you have read through the trial, you will be asked to answer some questions.

Please treat this as an independent exercise. We are interested in your opinions and therefore it is very important for the purposes of the research that you refrain from discussing the case with other people who may be participating in this study.

Judge's Instructions

Jim Anton has been charged with the crime of murder in the first degree. The Crown has the burden of proving that charge beyond a reasonable doubt. It is your duty to read all of the evidence, to decide the facts, and then to apply the law that I give you at the end of the trial.

The case will begin with opening statements from the prosecution and the defense attorneys. Each will tell you what they expect to prove. These statements are not evidence, they are only a summary to help you follow the case.

The prosecution will then call witnesses for the Crown. After the prosecution has finished questioning a witness, counsel for the accused will be allowed to question the same witness. After all the witnesses for the prosecution have been heard, the accused's attorney may choose to present witnesses on the accused's behalf.

Prosecution's Opening Statement

Darren Williams (deceased) and Jim Anton (accused) were friends aged 31 and 34 years old, respectively who lived in the city of Toronto. They met several years ago when they were both studying together at the University of Toronto.

Witnesses will testify regarding the events that transpired the evening of the killing. On this night, Jim, Darren, and two other male friends played cards at Jim's house. The men decided to place monetary bets on their card games, and by the end of the evening, Darren owed Jim one thousand dollars. Jim asked to collect the money that Darren owed him, but Darren refused to pay. Darren went to leave Jim's house, and Jim followed him outside where an argument over the money ensued between the two men. The two men walked away from each other after the argument and Jim was still extremely angry. About a half hour after they walked away from each other, the victim, Darren Williams, was found dead on the side of the road.

Witnesses will testify that Jim had been heard not only making death threats towards Darren, but that Jim has a history of verbal and physical violence towards others. Two witnesses will testify that on the night of the murder, Jim said to Darren, "If you don't pay up, I'm going to kill you."

Forensic examinations revealed that Darren Williams was killed by multiple stab wounds to the chest inflicted by a machete. Blood samples were found on Darren William's body near his stab wounds and you'll hear from an expert witness that the DNA in those blood samples matched the DNA in blood samples provided by Jim Anton. Our evidence will show that in a fit of rage over the card game, Jim Anton returned and

killed Darren Williams after their argument. As such, it is your duty to find him guilty of murder.

Defense's Opening Statement

Jim Anton did not kill his old time friend, Darren Williams. Not only were the two men best friends, they were like brothers. And like brothers sometimes do, Jim and Darren got mad at each other over a card game bet.

Witnesses, including Jim Anton himself, will testify regarding how close Jim and Darren were and how they often got into verbal arguments but were quick to forgive each other and move on. You will also hear from another witness who will testify that on the night of the murder and in the same neighbourhood where it occurred, she was out walking her dog and was approached by a strange man asking if she had any spare change.

Indeed, Darren was killed by the stab wounds he suffered to the chest and yes, some blood samples were found near the wounds. Even if the DNA in these blood samples did match Jim Anton's DNA, this is not enough evidence to conclude that Jim committed the murder. In fact, given that Darren was over at Jim's place that evening and that he had a nosebleed, it is not surprising that some of Jim's blood was found on Darren. This does not make Jim Anton a murderer, only someone who happened to shed blood due to a nosebleed. You will also hear that the murder weapon was never found and that Jim Anton never owned a machete.

Darren Williams' murder is beyond doubt a tragedy. What is even more tragic is that the true perpetrator of the crime is still somewhere out there, perhaps waiting to strike again. The prosecution will not be able to determine that Jim Anton was

responsible for his best friend's death. Therefore, you must find Jim Anton not guilty of murder.

Crown's First Witness: Constable Dirk McHugh

On Direct Examination by the Crown, Constable McHugh testified that:

- on the night of November 29, 2004, he and Sergeant Kealy took pictures of the crime scene and of Jim Anton's house
- the crime scene was located approximately 2 kilometres from Jim Anton's house and that the estimated time of the murder was approximately 8:20pm

CROWN AND MCHUGH GO THROUGH PICTURES AND EXHIBITS:

- photographs show Jim Anton's dining room table with empty soda cans, a deck of cards, and two of four chairs knocked over
- photograph of Jim's front hallway shows a door knob impression in the wall and a splintered door hinge
- photograph of Jim's front yard shows scuffle marks in the grass and spit on the driveway
- photograph of Darren Williams' body with blood stains and 4 stab wounds to the chest
- photograph showing positioning of the body and the condition of the deceased's fingernails as consistent with the victim struggling with his assailant before being stabbed in the chest

Exhibit 1: - photograph of two blood samples obtained from the crime scene NOT belonging to the victim himself

Exhibit 2: - photograph of two blood samples obtained from Jim Anton

Exhibit 3: - close-up photograph of the victim's stab wounds
- entry marks consistent with marks left by a machete knife

When Cross Examined by the Defense, Constable McHugh testified that:

- it was unclear whether or not the door knob impression and splintered door hinge had occurred the night of the murder
- there were blood stains at the bottom of Jim Anton's front steps
- that Jim Anton originally refused to give a blood sample, therefore the blood samples had to be obtained through court order¹⁵
- the machete knife used in the stabbing has not been located

¹⁵ In the Weak DNA versions, the defendant willingly gives the blood sample.

Crown's Second Witness: Rosa Scove

On Direct Examination by the Crown, Rosa Scove testified that:

- she is Jim Anton's next door neighbour and has been so for the past 6 years
- on the evening of November 29, 2004 at about 7:30pm, she heard a commotion coming from inside Jim's house. It sounded as though two men were screaming at each other
- she heard a banging that sounded like Jim's front door and from her living room window she saw Jim and two other men exit Jim's house.
- she opened her window slightly to hear what was going on and she heard Jim and one of the other men arguing over money
- she heard Jim say to the man, "If you don't pay me, I'm going to kill you." and the two men were getting into each other's faces
- she saw the third man get between the two who were fighting in order to break them up
- she saw the eventual victim walk away from the house and head down the street while Jim and the man who tried to break Jim and Darren up went back into Jim's house
- she had on two separate occasions witnessed Jim punch another man on his front lawn after an argument

When Cross Examined by the Defense, Rosa Scove testified that:

- on one of the occasions when she witnessed Jim punch another man, the man had hit Jim first
- she was not wearing her eyeglasses when she watched through her window
- she has on several occasions asked Jim to watch her house for her while she has been away on vacation

Crown's Third Witness: Ronald Fillmore

On Direct Examination by the Crown, Ronald Fillmore testified that:

- he had been friends with both Jim and Darren for over 10 years
- he had been playing cards at Jim's house the night of the murder
- he, Jim, Darren, and a fourth friend had been playing poker and betting on the games
- Jim was having a lucky night and winning a lot of the games
- Darren kept thinking he would win and kept betting on new games until he owed Jim one thousand dollars
- Jim asked Darren to write him a cheque for the one thousand dollars
- Darren said he would not write the cheque and that he had no intention of ever paying Jim
- Jim jumped out of his chair, knocking it over, and went right up to Darren's face and started screaming at him to pay up
- Darren told Jim he was out of control and said he was leaving
- Jim followed Darren out of the house, yelling and swearing at him and spitting on the ground. As he walked out, Jim tripped on the stairs, fell down, and his nose began to bleed. He said to Darren, "If you don't pay me, I'm going to kill you."
- Jim and Darren were getting in each other's faces, so he stepped between the two of them to break up the fight
- Darren walked away by himself down the street
- he and Jim went back into Jim's house
- he told Jim he was out of line with how he reacted and what he said to Darren
- he left Jim's house at about 7:50pm, about 10 minutes after Darren had walked away

When Cross Examined by the Defense, Ronald Fillmore testified that:

- in the past, Jim had threatened to kill him when he got really mad but had never followed through on the threats
- after Darren had left and he (Ronald) and Jim went back into Jim's house, Jim acknowledged that he had been inappropriate with Darren and said he would call him first thing in the morning to apologize
- Jim said he was going to call it an early night and go to bed

Crown's Fourth Witness: Dr. Eileen Schumann

On Direct Examination by the Crown, Dr. Schumann testified that:

- she is a forensic scientist who specializes in DNA evidence with publications in numerous journals and presentations at several professional conferences
- she is the lead forensic scientist at the Avery DNA laboratory located in Ottawa, Ontario, and has been working there for over 15 years
- she has been qualified as an expert witness in DNA analysis and population genetics by other courts over 20 times
- forensic DNA science is a branch of science concerned with the identification of individuals who match DNA profiles found at a particular place such as a crime scene
- population genetics is the branch of science in which statistics that explain the frequency with which a particular DNA pattern appears in a given population are studied and analyzed
- the guidelines for proper collection of DNA evidence include:
 - o proper training to specialized forensic police officers in the areas of collection, preservation, and packaging of DNA evidence
 - o officers taking precautions such as wearing gloves and facemasks to minimize their exposure to infectious agents, as well as to preclude transfer of their own DNA to evidence
 - o separate packaging of samples from different crime scenes as well as crime scene samples and comparison samples from persons of interest
 - o where relevant, items should be handled and packaged in a manner that preserves trace evidence such as hair, fibre, paint, soil, or gunshot residue
 - o for every evidence item collected, the officer should note who collected the item, the date, the location, and a brief item description
 - o item packaging should be properly labeled and closed to protect the items from extraneous substances, as well as from unauthorized access
 - o it is vitally important to protect evidence from exposure to heat and moisture, both of which have deleterious effects on DNA
 - o wet items require passive air-drying prior to packaging
 - o to maintain continuity of evidence items and therefore admissibility in Court, items should be uniquely labeled, properly packaged, and each transfer of the item should be documented

- she was asked to examine DNA evidence in the form of blood samples that were found on Darren Williams' body the night he was murdered along with blood samples obtained through court order from the defendant, Jim Anton
- to her knowledge, all the proper guidelines and procedures for the collection and analysis of DNA evidence had been followed
- the DNA test results showed a match between Jim Anton's blood samples and those found on the victim's body

On Cross Examination by the Defense, Dr. Schumann testified that:

- there are two types of errors (false positives) that can occur with DNA evidence
- a Random Match Error is the probability of a match being declared due to random chance
- a Lab Error Rate is the probability that a match report was declared due to a human error that occurred in the DNA lab
- Error rate statistics can be presented in several different, yet equivalent ways such as frequencies, probabilities, and ratios. For example, to say there is an error rate of 1 in 1000 is equivalent to saying there are 1000:1 odds, or a probability of 0.1% that an error occurred¹⁶
- the probability of either a Random Match or Lab Error for the current DNA evidence was about 1 in 1,000,000,000¹⁷
- except for the blood samples, no other DNA evidence was submitted for analysis

End of Crown's Case

¹⁶ In the general expert conditions, this paragraph will not be included

¹⁷ In the ratio presentation version, this value will be 1,000,000,000:1. In the probability version, this value will be 0.0000001%. In the Weak DNA versions, the values will be 1 in 50 (frequency presentation), 50:1 (ratio presentation), and 2% (probability presentation).

Defense's First Witness: Jim Anton

On Direct Examination by the Defense, Jim Anton testified that:

- he and Darren Williams had been best friends since they met at university 12 years ago and that Darren was like a brother to him
- he had invited Darren and two other friends to play cards at his place on the night of November 29, 2004
- everyone was betting for money on the poker games they played
- Darren lost one thousand dollars to him but that when he went to collect the money, Darren refused to pay
- he got angry and started yelling at Darren to get him to pay up
- that the argument continued in his front yard and that he got so angry at Darren that he said to him, "If you don't pay me, I'm going to kill you" but that he said this without thinking and that he had no intention of following through on the threat
- that on his way into the front yard, he tripped and fell and as a result, his nose started to bleed
- after Darren walked away and he (Jim) had calmed down, he felt extremely bad about what he had said and how he had acted toward Darren and that he planned to call Darren in the morning to apologize
- he did not currently own nor had he ever owned a machete
- he did not kill Darren Williams

When Cross Examined by the Crown, Jim Anton testified that:

- at approximately 8:00pm on the night of the murder, he left his house to go to the corner store to get some milk
- the store he went to was in the opposite direction from where Darren's body was found
- he had the tendency to "blow up" easily when he was mad about something
- he had on 2-3 occasions in the past five years been so angry that he got into a fist fight with various male friends

Defense's Second Witness: Elliot Sampson

On Direct Examination by the Defense, Elliot Sampson testified that:

- he was the fourth person who had been playing cards at Jim Anton's house the night of the murder
- he had been friends with both Jim and Darren for over 10 years
- on the night of the murder, he had left Jim's house at approximately 6:45pm before Jim and Darren had started fighting
- when he left, Jim and Darren were laughing and talking about the last poker hand they had played
- he had witnessed Jim and Darren get into many fights and arguments over the years but that they always forgave each other and stayed best friends
- in the context of these past fights and arguments, he had heard Jim and Darren say things such as "I'm going to kill you" to each other but that neither had ever followed through on the threats
- to his knowledge, Jim had never owned a knife or any kind of weapon

When Cross Examined by the Crown, Elliot Sampson testified that:

- Jim had once told him that he would love to get a machete one day
- Jim had recently told him that he was afraid he would not have enough money to pay his mortgage that month and that this would be the second month in a row
- Jim said the bank had allowed him to pay late last month but warned him not to let it happen again
- Jim said he would do anything to get his hands on some extra money

Defense's Third Witness: Anna Goldstein

On Direct Examination by the Defense, Anna Goldstein testified that:

- that she lived a block away from where Darren's body was found
- she did not know Jim Anton personally, but that she had seen him around the neighbourhood on different occasions
- that she was out walking her dog between 7:00 and 7:30pm on the night of the murder
- that during her walk, a strange man whom she had never seen before approached her and asked if she had any money to spare
- that the man seemed nervous and kept looking around him and that he was probably in his mid-40's, about 5'11" tall, weighing approximately 175lbs, with brown hair and brown eyes
- that she told the man she had no money for him
- that after she told him this, he frowned and looked as though he was going to take a step closer to her
- that her dog barked and growled as the man started to move and that he immediately backed up and walked away
- that this incident was somewhat frightening to her and that she considered calling the police right away but decided not to because she thought maybe she was overreacting
- that after she heard about Darren's murder the next day, she immediately thought of the strange man and decided at that point to call the police

When Cross Examined by the Crown, Anna Goldstein testified that:

- the man could have been someone who lived in the neighbourhood who she had never seen before
- the man never verbally threatened her in any way
- that the man did not give any indication that he was carrying a weapon on him
- that she could not tell where the man was headed after her encounter with him

End of Defense's Case

Judge's Instructions

Members of the jury, I will now instruct you as to the laws that apply to this case. The law is intended to be helpful to you in reaching a just and proper verdict in the case, however, it is not binding upon you as members of the jury and you may accept or reject it as you feel is appropriate to the case at hand.

The charge against Jim Anton is murder in the first degree. When dealing with a charge you must be satisfied that each element of the verdict has been proven by the Crown. For a finding of murder in the first degree, the intent to cause the death or bodily harm likely to cause death had to have been planned and deliberate by the accused. The presumption of innocence is in the accused's favour and the burden of proving him guilty beyond a reasonable doubt is on the Crown. You must decide whether Jim Anton is guilty or not guilty of murder in the first degree.

While you must give respectful attention to the laws, you have the final authority to decide whether or not to apply a given law to the acts of the defendant on trial. You, the jurors, represent the community and it is appropriate to bring into your decision, both the feelings of the community, and your own feelings based on your conscience. Despite your respect for the law, nothing would bar you from acquitting the defendant if you feel that the law, as applied to the situation before you, would produce an inequitable or unjust verdict.

Appendix O

Summary of Evidence in Favour of:

Defense

- defendant willingly gave blood sample (WEAK DNA CONDITION ONLY)
- murder weapon has not been located
- neighbour serving as a witness was not wearing her glasses at the time
- neighbour trusts defendant enough to watch her home while she is away even though she has seen him act violently in the past
- defendant acknowledged after the fact that he had been inappropriate in his response to his friend and he planned to phone and apologize the next day
- defendant has never been known to follow through on threats of “I’ll kill you”
- defendant has never owned a machete
- a woman walking her dog in the neighbourhood was approached by a strange man on the same night as the murder
- 1 in 50 chance of a random match or lab error (WEAK DNA CONDITION ONLY)

Crown

- crime scene is close to defendant’s house
- defendant refused to give blood sample, therefore it was ordered by the court (STRONG DNA CONDITION ONLY)
- evidence of an argument at the defendant’s house
- DNA in blood found on the victim match defendant’s DNA
- neighbour heard a commotion at the defendant’s house on the night of the murder and she heard defendant say, “I’ll kill you” to the victim

- neighbour saw defendant and victim engaged in a heated discussion that had to be broken up by a third person
- defendant has a history of anger and violence
- a friend of the defendant and the victim witnessed the fight between the two and heard defendant say "I'll kill you"
- 1 in one billion chance of random match or lab error (STRONG DNA CONDITION ONLY)
- defendant left to buy milk at about 8pm
- defendant was heard saying in the past that he would love to get a machete one day
- defendant admitted to friend that he was behind on his mortgage and that he would do anything to get his hands on some extra money

Appendix P

Based on the information you read, how easy was it for you to understand the statistical information that was presented about error rates associated with DNA evidence? Please decide on a number between 0 and 100 where:

0 = *Extremely difficult*

100= *Extremely easy*

YOUR RATING (between 0 and 100): _____

Appendix Q

List of Acronyms Used

Acronym	Meaning
BWS	Battered Woman Syndrome
DNA	Deoxyribonucleic Acid
LE	Lab Error Rate
M	Mean
PPV	Positive Predictive Value
RMP	Random Match Probability
SA	Social Agency
SD	Standard Deviation
SE	1. Single-Error 2. Standard Error
SCE	Single Combined Estimate
SOE	Strength of Evidence
TSE	Two Separate Estimates
TSECI	Two Separate Estimates Plus Combination Instructions