Rhyme or Reason:
An investigation into the physiological underpinnings of the Wason selection task

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Danni Bayn

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Charles R. Fletcher, Advisor

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Dedication

This dissertation is dedicated to Gunther, who has always been by my side.

ABSTRACT

The Wason Selection task is a deceptively simple task that can take on many different forms. When its form is abstract, participants scratch at their heads and fail to grasp the underlying logic. However, changing its form to a story, or a familiar situation almost instantaneously elicits the correct response. The explanation for this thematic effect has led to a substantial amount of consternation within the field and two opposing theories have pushed their way to the forefront. Social Contract Theory argues that humans have evolved a specialized cheater detection mechanism that enables us to reason about social interactions and cost-benefit deals. When the thematic form of the task is in the form of a social contract, this reasoning mechanism is chosen pre-emptively as the 'weapon of choice' in solving the problem. Relevance theory, on the other hand, argues that the thematic effect is due to mechanisms of discourse comprehension. However, changing the task so that it looks more like a story, triggers the comprehension mechanisms that we have already developed through other social interactions. According to Relevance theory, the Wason Selection task is not a reasoning task at all, and should not be tested as such.

Through three experiments, this study develops and tests a new, within-subjects procedure as well as new sets of materials. After ensuring that the new procedure and materials elicit this thematic effect and other common findings, a physiological experiment is conducted. Based on the predictions of Social Contract theory and related physiological work in emotional reasoning (e.g. Bechara, 2002), it was predicted that Wason tasks would elicit greater Galvanic skin responses when compared to matched Comprehension stories. Participants did have a significantly higher galvanic skin response for the Wason tasks, indicating a higher level of anxiety. This finding shows that there is a sort of reasoning beyond discourse comprehension involved in the Wason task. A discussion centered on the implications for future imaging studies and the Wason task as a whole is included.

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Chapter One: Introduction

Rhyme or Reason: An investigation into the physiological underpinnings of the Wason selection task

Historically, philosophers and psychologists have viewed reason and rationality as two of the primary characteristics that separated Man from animal. They argued that reason enabled us to see and understand the truth, and rationality allowed us to make logical decisions based on that truth. Both were commonly thought to be ideals that were attained through study and reflection. However, as psychologists and philosophers studied and reflected, they realized that humans, even the most educated among us, might never reach those ideals. In fact, theories have emerged that enable science to understand that these ideals of reason and rationality are quite different from actual behavior.

There are currently two different types of theories of reasoning and, with them, two different types of theories of rationality. First, there are the normative theories of reasoning; they describe what people *ought* to do. We *ought* to be able to rationally think through alternatives while problem solving, so that we can make better decisions (Yates, 1990). Along with this comes the normative theory of rationality, where humans reason in a logical fashion and strive, unbiased, towards truth.

Opposed to the normative theories are the descriptive theories of reasoning. These theories attempt to describe how we *do* behave, rather than how we *ought* to behave. Descriptive theories try to explain why humans often behave in ways that are self-contradictory and against our own self interest; why we often let emotions, heuristics, and biases affect our judgement (Bechara, Damasio, & Damasio, 2000; Gigerenzer & Goldstein, 1996; Plous, 1993). Along with the descriptive theory of reasoning comes the second theory of rationality, where people act not in terms of logic, but in terms of what will help them reach their goals (J. S. Evans & Over, 1996).

Much of the current research on rationality and reasoning has been conducted in a single domain and on a single task, i.e. the Wason Selection task (WST). This task has been the subject of an amazing amount of controversy. The next three sections this chapter seeks to familiarize the reader with the WST. First, we will discuss the general

structure of the WST and its key features. Second, this chapter will explain the four main findings in this field, the Thematic Effect, Matching Bias, Training/Transfer, and Wording changes will be explained. This discussion of the major findings in the field will form the basis for the third section of this chapter, which will go through seven different theories for the WST and explain the evidence for and against each. This will provide the background information needed to fully understand the experiments that will be described in later chapters.

1 The Task

Let us say that you are presented with the problem in Figure 1

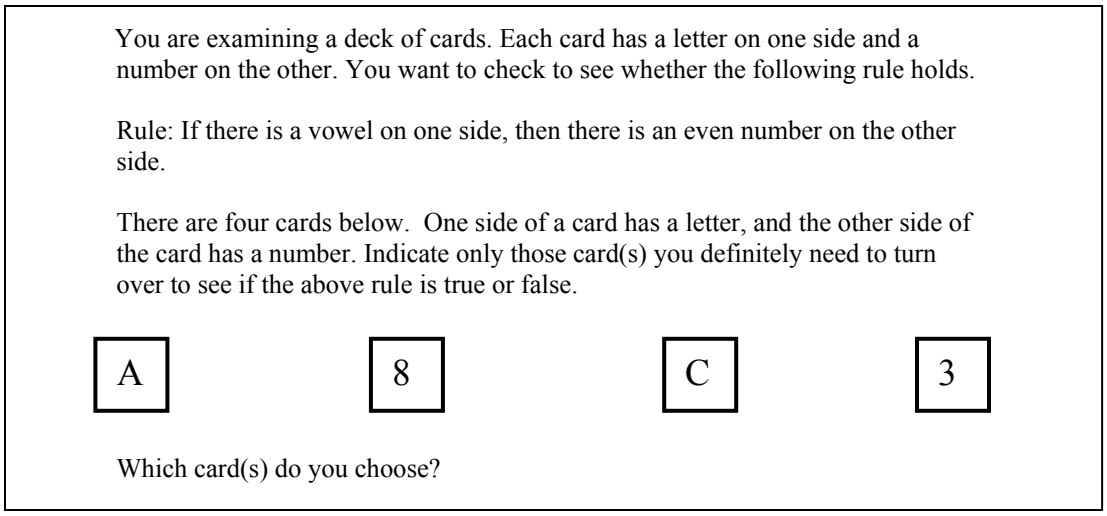

Figure 1: Standard, Abstract Wason Selection Task

How would your answer change if you were given the problem in Figure 2?

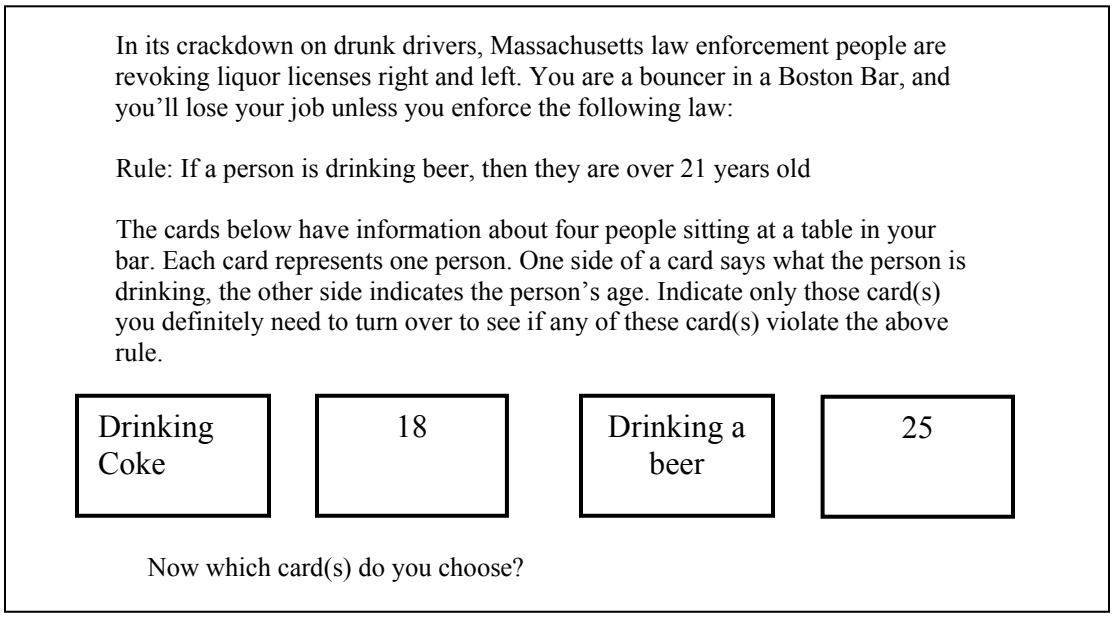

Figure 2: Thematic Wason Selection Task

These tasks are structurally and logically identical. But many people give very different answers for each of them. The first task is Wason's original selection task (Wason, 1966; Wason & Johnson-Laird, 1972; Wason & Shapiro, 1971).

There are four different parts to the WST. All four aspects of this task have been extensively studied and modified. The first part of the task is the story presented at the beginning. In the first problem, Wason's original task, the story is very abstract and unfamiliar. The story in the second problem, the thematic version of the Wason, describes a situation that most of us find familiar. The second part of the WST is the instruction section. These instructions tell you to pick a card (or cards) to determine if the rule is true or false. Third, and often the most crucial, is the rule that you are to reason from. In the first condition, the rule is in the form of a standard conditional: "If P, then Q". Lastly,

there is the set of four cards that you are asked to choose from[1]. When solving this problem, it is assumed that the reasoner understands that each card has something on the other side, which they would be able to examine if they turned the card over.

Each of these four cards represents a different logical inference. For example, if given the rule "If P, then Q", one would have to choose from the cards "P", "not P", "Q", and "not Q". The logically correct answer is to pick both "P" and "not Q". Picking "P" represents the inference Modus Ponens: when given a true antecedent (P) one can conclude that the consequent (Q) is true as well. Picking "not Q" represents the inference Modus Tollens: when it is known that the consequent (Q) is false, one can conclude that the antecedent (P) is also false. The other two cards, if picked, indicate a logical fallacy. Choosing "not P" is the logical fallacy of Denying the Antecedent, while choosing "Q" is the fallacy of Affirming the Consequent. The table below illustrates all of these choices and the logical inferences that they each represent.

Card Chosen	**Logical Inference**
P	Modus Ponens -Given a true antecedent, concludes that the consequent is true.
Not P	Denial of the Antecedent (FALLACY) -Given a false antecedent, concludes that the consequent is false.
Q	Affirming the Consequent (FALLACY) -Given a true consequent, concludes that the antecedent is true.
Not Q	Modus Tollens -Given a false consequent, concludes that the antecedent is false.

Table 1: Given the rule "If P, then Q"

On the first story presented, the original Wason task, the majority of people perform very poorly. Chance on this version of the WST is 6.25% while performance is often less than 10%. Conversely, performance on the second version, the thematic WST, is much higher. It has ranged from 25% up to 80% (L. Cosmides, 1989; Klaczynski et al.,

[1] There is another version of the Wason Selection task called the RAST (Reduced Array Selection task). In this version of the task, participants are shown two cards at a time and asked to choose between them (Margolis, 1987). Due to space limitations, this version of the task is not discussed in detail.

1989). The two most common errors, for both tasks, are to pick either "P" alone, or to pick "P" and "Q". From these results, Wason initially argued that people have a confirmation bias that interferes with their ability to reason logically. Since then, researchers have been trying to either prove or disprove this claim.

The second task is a modification of the infamous "Drinking Age" problem from Griggs & Cox (1982). They found that participants performed significantly better on this task (in terms of providing the logically correct answer) than on the first one (Cox & Griggs, 1982; Griggs & Cox, 1982). This facilitation for performance is termed the thematic materials effect and is proven to be robust and replicable (Cox & Griggs, 1982; Griggs & Cox, 1982; Klaczynski, Gelfand, & Reese, 1989).

The majority of the research on the WST has compared tasks similar to the above two; they are often termed abstract selection tasks and thematic selection tasks, respectively. Research on the Wason Selection task has tried to modify the different components of the task itself, as well as varying the amount of feedback and training given to participants. Four general findings have emerged from this research:

1. The thematic materials effect: Performance increases when a familiar context is added.
2. There is a matching bias for card selections; participants often choose cards that are represented in the rule (J. S. Evans, 1972; J. St. Evans, 1993; J. S. Evans, Legrenzi, & Girotto, 1999; Roberts, 2002).
3. Transfer and training generally do not occur on the WST. Only training that is likely to associate strong emotions with the correct answer are likely to increase participant performance (Houde et al., 2001; Houde et al., 2000). Standard methods of training fail (P. W. Cheng, Holyoak, Nisbett, & Oliver, 1986; J. S. Evans, Newstead, & Byrne, 1993).
4. Changing the wording of the instructions, the rule, or the cards can affect performance (i.e. Griggs & Cox, 1982; Kroger, Cheng, & Holyoak, 1993; Margolis, 1987).

Each of these findings is discussed in more detail in section 2: Research on the WST.

2 Research on the WST

One would think that over the course of 42 years, the established findings on the WST would number more than four. This is not the case. Each of the findings above (i.e. Thematic effect, Matching Bias, Training/Transfer, and Wording changes) is discussed in more detail along with some key experiments that illustrate them. Appendix A summarizes these findings.

Thematic Effect

The thematic effect has been the most widely cited of any of the behavioral findings, and the question of why it occurs is the main point of controversy between the competing theories in the field. The thematic effect was first pointed out by Wason & Shapiro in 1971 (J. S. Evans et al., 1993). They gave participants a problem involving a transportation rule. For example, "Every time I go to Manchester, I use the train". They found significant facilitation for logically correct performance with this version when compared to the abstract version of the WST. However, later studies using the same material were unable to replicate their effects, because context is not as important as familiarity. The first thematic problem that produced reliable facilitation was D'Andrade's Sears problem (described by Griggs, 1983). This problem gave participants the simple rule "if the receipt is for over $30, then it must have the manager's signature on the back". Despite not having actual experience with this situation, it was familiar enough to improve performance.

Two main studies established the thematic effect. The first is Cox & Griggs (1982). They tested participants on five different versions of the WST, listed in order of decreasing familiarity:

1. A drinking age problem (example given previously, p. 4).
2. A problem relating age to color of shirt (arbitrary thematic)
3. The contrapositive to the drinking age problem, e.g. "If they are under 19, then they must drink coke"
4. An against experience version of the drinking age problem, e.g. "If they are under 19, then they must drink beer"

5. The standard WST.

They predicted that participant performance would increase as the familiarity of the task increased. Cox and Griggs (1982) results supported their hypotheses: for each of the conditions listed, they found the following accuracy rates: (1) 91%, (2) 54%, (3) 50%, (4) 25%, and (5)[2] 4%. In addition, they found that the most common error was selection of the "P" & "Q" cards, a partial replication of Wason (1966). They conclude that participants' performance will vary depending on how familiar they are with the context and that thematic material is always more familiar.

The second study is Griggs & Cox (1982). Through three different experiments, they compared three types of stories: (1) strong thematic, the Drinking Age problem from Cox & Griggs (1982); (2) weak thematic, a modified version of Wason & Shapiro's (1971) Transportation problem (p. 6); and (3) an abstract problem. They also compared the effects of rule form. They tested rules in the form of "If P, then Q" and "P only if Q". They found a large thematic effect for the drinking age problem, but not for the transportation problem. Griggs & Cox (1982) conclude that, even though participants were familiar with the cities mentioned in the transportation problem, the rule itself was not familiar.

Since these two studies, thematic effects have been observed in a variety of different types of experiments. The current question does not concern whether it does occur, but why it occurs.

Matching Bias

Matching bias is the tendency for participants to select cards that make the antecedent and the consequent true, regardless of the presence of negatives in the rule or on the cards (Evans, 1993). If the given rule is, "If the letter is A, then the number is not a 3", participants often choose "A" and "3", corresponding to "P" and "Q" (this happens only when "not 3" is *not* one of the cards). As a point of clarification, matching bias is distinct from confirmation bias. In confirmation bias, participants try to confirm beliefs they already hold. In the example above, they generally choose to make the antecedent

[2] Please note that this is below chance.

and the consequent true. Only through the introduction of negatives into the rule can matching bias be separated out from confirmation bias.

Initial studies on matching bias did not use the WST. They either used a truth table task or they asked participants to generate verifying and falsifying cases for different conditional statements (Evans, 1972). The first study using the WST to test matching bias was Oaksford & Stenning (1992). They argued that the only way to unconfound matching bias from logical answers was to introduce negatives into the rule. This method of altering the negatives is now called the rotating negations paradigm and it leads to four different versions of the original rule: (1) "If P then Q", (2) "If not P, then Q", (3) "If P, then not Q", and (4) "If not P, then not Q". The logically correct answer for each of these forms is different, whereas the wording on the cards can be altered so that the matching answers stay the same.

Using this method, they replicated Evans (1972) and found a very unusual pattern of results. For rules like "If not P, then Q", most participants chose "not P" and "Q". In non-negated versions of the WST this is a very uncommon response, yet, for this rule, it represents a double match. Oaksford & Stenning (1992) conclude, "Matching bias suggests that people are irrational and that they violate deep-rooted intuitions concerning the nature of man as a rational animal" (p. 835).

Many experiments have examined the effects of changing the logical form of the presented rule and its effect on participant performance. However, since this variable is not directly relevant to the proposed study, a more detailed review of this literature can be found in Appendix A (p. 93).

Training and Transfer

The efficacy of training on the WST and the existence of transfer between different forms of the WST are more controversial than other findings. While some types of training methods are clearly ineffective, others have led to conflicting, results. Transfer, on the other hand, has been shown to exist, but only negatively. First, we will discuss the research on Training and the WST and then look to how Transfer may play a role.

Training

Training can take one of two forms: (1) Training can focus on the general subject matter, in the hope that the knowledge will generalize, or (2) Training can focus on the specifics of the task itself (Cheng et al. (1986). Over the course of three experiments, Cheng tested both forms of training (Cheng et al., 1986). The researchers compared performance on the abstract WST and a permission rule WST[3] on two types of general training:

1. Full semester course in Logic: Participants were tested at the beginning of the class and at the end.
2. Obligation training (trained on how obligations and permissions worked).

and four types of focused training:

1. Rule: Participants were trained on the rule "If P, then Q".
2. Example: Participants were shown an example of how to solve the problem.
3. Rule plus Example: A combination of one and two above.
4. Contingency training (check for contingent situations): Participants were encouraged to look for situations that would prove the rule false.

They found that only the following types of training were effective: Rules plus example and Obligation training. All other types of training proved ineffective.

Klaczynski et al. (1989) provides partial support for Cheng et al's (1986) findings by comparing participant performance over the course of nine WSTs. After each of the first five problems, half of the participants received a detailed explanation of how to do the task. After the fifth problem, participants were tested on four more. They found that explanations on abstract problems improved performance for later abstract problems. Conversely, explanations actually decreased performance for thematic problems (Klaczynski et al., 1989). This is a partial support and partial refutation of Cheng et al's

[3] The Permission Rule WST is a version of the thematic WST. A thorough description of what constitutes a permission rule is described later (p. 18).

(1986) finding that Rules plus explanation training improved performance on both versions of the task.

Price & Driscoll (1997) also investigated the effects of providing an explanation to participants, but their results are different from both Klaczynski et al (1989) and Cheng et al. (1986). They ran participants through three different stages. In the first stage, participants were shown either an abstract or a thematic problem (to establish baseline results). In the second stage, they were shown an abstract problem (to investigate transfer). In the final stage, they placed all participants into three groups. One group received declarative feedback (the experimenter explains the problem in more detail, very similar to Klaczynski et al., 1989), a second group received analogical feedback (the experimenter compares the problem to a previous one), and the third group received no feedback at all. Finally, they were all asked to solve one last abstract problem (Price & Driscoll, 1997). Not only did they find no evidence of transfer or improved performance after repeated exposure, they found no effect of feedback on performance. Declarative feedback did decrease "Q" selections, but did not increase accuracy.

Though all of the above studies fail to agree on *how* to improve performance, they all agree on *why* people perform poorly. All three studies argue that the reason people fail to do well on the WST in its various forms is that participants initially fail to form an appropriate schema for solving the problem and that most types of training are not successful at encouraging participants to modify their schemas appropriately.

All three of the above studies focused on trying to get people to notice the logical, or more general, form of the problem and to then use that knowledge to solve the specific examples that they were given. Houde et al (2000, 2001) tried a very different approach. They measured participant performance and brain activation (via PET) while doing the abstract WST after two types of training. The first type of training was very similar to the methods above; they gave participants detailed explanations about the logical nature of the task and about how to solve them. The second type of training, called logic-emotion training was similar to the first, except that while training the participants on the logical nature of the task, they added an emotional context. In addition to explaining the task,

experimenters also told participants about matching bias (p. 7) and how they could avoid falling into this "trap". They found that only logic-emotion training improved participant performance. This improvement was linked with a change in brain activation. Participants who had received the logic-emotion training had greater activation in the right ventromedial prefrontal cortex. This area is suspected to be linked to emotional reasoning (e.g. Bechara, 2001; Bechara et al., 2000; Damasio, 1996).

However, it is not known whether Houde's findings will generalize to thematic versions of the task, or even whether the addition of an emotional context to the training is what led to improved performance. In the logic-emotion training condition, experimenters also informed participants of matching bias. The behavioral improvement that they observed could simply be due to them explicitly telling participants that their most likely strategy was flawed. This could also have led to the change in activational patterns as participants experienced emotional conflict or frustration as they sought a new strategy.

Transfer

While training is something that occurs between two examples of the same type of task, the term transfer is reserved for situations when doing one task affects performance on a later (and usually different) task. Transfer is often measured through order effects. If seeing problem A before problem B improves performance on B, it can be said that transfer may have occurred. Early studies with the Wason found little transfer between abstract and thematic versions (Johnson-Laird, Legrenzi, & Legrenzi, 1972; Wason & Shapiro, 1971). Evans et al. (1995) and Evans et al. (1996), described in more detail in Appendix A (p. 93), used a within-subjects design when comparing different rule forms (e.g. "If P, then Q" or "P only if Q"). They found no evidence of transfer between different types of rules, or even for rules of the same type.
Similarly, Osman & Laming (2001) tested repeat exposure to abstract and thematic problems (with and without negatives). Besides finding evidence of matching bias, they found that participants were, for the most part, entirely consistent in their card selections across problem type (Osman & Laming, 2001); i.e. the cards that they chose for the first

abstract problem that they saw were the same cards that they chose on the sixth abstract problem that they saw. However, the rate of consistency did decrease when negatives were increased. Osman & Laming argue that this is because the negatives confused participants. In addition to exhibiting no signs of transfer, participants reported that they thought the two types of problems were entirely unrelated despite their nearly identical form.

Cox & Griggs (1982), described in more detail previously (p. 7), is one of the only studies to find transfer. They found that when the Drinking Age problem was presented first, performance on the Age Color problem *and* the against-experience problem increased. However, performance on the drinking age task dropped if it was not presented first. Ironically, regardless of when it was seen, performance on the abstract did not change. They conclude that performance on problems that were partially thematic may increase if preceded by a more thematic one.

Overall, even though training and transfer on the WST have been studied quite a bit, the only agreed upon findings are: (1) Most training methods that are effective in other domains are ineffective in this one, and (2) Transfer, in particular positive transfer, is virtually non-existent between abstract and thematic versions of the WST.

Wording Changes

Finally, it is fairly well established that performance on the WST is highly susceptible to change when the wording of the problem changes. For example, using "must" in a rule, asking participants to "falsify" a rule, or having explicit negatives all improve performance. Generally, studies that have investigated wording changes in the WST have done so very generally and under the general argument that performance on the WST is due to a materials effect[4].

Griggs & Cox (1982), described previously (p. 7), was one of the first to find a substantial effect of wording on performance in the WST. They found that when they

[4] Only the findings from the Griggs & Cox (1982) study are described in detail here. For descriptions of other studies that have found significant performance differences due to wording changes, please see Appendix B (p. 95).

asked participants to look for "violators" of the rule, rather than to "determine if the rule is true or false" performance was increased on thematic materials (not abstract). They argue that by mentioning "violators", participants are cued into a detective set that triggers them to search their memory for counter-examples.

A common argument that has stemmed from the research on wording changes of the WST is that the thematic effect is merely due to a materials effect. Margolis (1987) argues that participants misunderstand what the cards are supposed to represent; they see the cards as representing an open system rather than a closed system (categories rather than exemplars). By clarifying that the cards were exemplars, she found facilitation. In addition, Fiedler & Hertel (1994) found that violation instructions yielded just as much facilitation for non-social contract stories as with social contract stories.

Of course, other theorists argue that the changes in wording either make certain features more relevant (J. S. Evans et al., 1993; D. Sperber, Cara, & Girotto, 1995) or help cue the participant into using a particular strategy (P. W. Cheng & Holyoak, 1985; L. Cosmides, 1989). All that is agreed upon is that the wording of the WST can facilitate or hinder performance, not how.

These four findings (the thematic effect, matching bias, the lack of transfer or training, and the effects of wording on performance) have been studied extensively within the WST. While there may be disagreement as to the specifics of these findings, and while there is certainly disagreement over why these *are* the findings, there is no doubt that they occur. The next section will describe some of the many theories that have been presented over the years to explain them.

3 Different theories for the WST

Over the years, many different theories have been proposed to account for these curious behavioral results. Out of all these theories, seven are still standing. These seven theories have been broken up into two categories: (1) domain general and (2) domain specific. While all of these theories will be described, the two theories that specifically

relate to the study at hand will be discussed in much more detail. For a more thorough discussion of the other five, please see Appendix D (p. 99).

Domain General Theories

There are three different domain general theories that attempt to explain performance on the WST. In addition, they all try to explain reasoning and deduction processes in general. These three theories are: (1) Mental Logic theory, (2) Mental Models theory, and the (3) Heuristic-Analytical Model.

Mental Logic Theory

Rips (1989) first developed the Mental Logic theory as a general theory of reasoning and deduction. Only after its inception was it applied to the WST. The Mental Logic theory has had many different names. Originally, it was (and, at times, still is) called the Natural Deduction System (Rips, 1989, 1990, 1993). It has also been called Formal Rules theory (J. S. Evans et al., 1993), Syntactic theory (Leighton & Dawson, 2001), and Natural Logic theory (Braine & O'Brien, 1991). Only the phrase Mental Logic theory will be used in this paper (J. S. Evans, Clibbens, & Rood, 1995). This model was developed by examining participants' performance on other logical puzzles, i.e. a game called Knights and Knaves (one tells the truth, the other lies). Through think-aloud protocols, it was deduced that participants think and reason logically. There are three general tenets to this theory:

1. There is an inherent logical system that guides reasoning.
2. This system is comprised of one set of abstract inference rules and/or schemas.
3. This set is used in a general-purpose way, in all domains, for all problems.

Essentially, people can reason logically, but this logic is a "natural logic". Some of the rules and inferences are made explicit, while others are not. Thus, "people's logical reasoning algorithms are sound but constrained by cognitive limitations" (Oaksford & Chater, 2001). In practice, we may misrepresent a problem or it may be too complex for us to hold in working memory at once. An example of an explicit rule would be Modus Ponens (see Table 17). Modus Tollens, on the other hand, is modeled implicitly. The

more rules that need to be applied to solve a problem, the more likely mistakes will be made. As a side note, they argue that, through experience, pragmatic rules can be added to this innate system.

Mental Models theory

Next is the Mental Models theory (Johnson-Laird & Byrne, 1991). Under this theory, people do not use specific inference rules during reasoning, but instead, create, modify, and reason from mental models that represent possible states of the problem. The Mental Models theory proposes that reasoners go through three stages:

1. The reasoner studies premises and creates a mental model of a possible state of affairs applying to them.
2. The reasoner forms a tentative conclusion, based on the premises, that is new and informative (not a trivial inference).
3. The reasoner looks for counter-examples to the model and their conclusion from the model. If none is found, then the conclusion is accepted.

To illustrate these stages, take the following example: Initially, you are given "If P then Q". This forms a mental model that looks like, in Johnson-Laird & Byrne (1991) notation, "[p] q" (the brackets mean that that component is exhaustively represented). On the other hand, if the rule is "P if and only if Q", the initial model would be represented as "[p] [q]". When participants are presented with the WST, they initially have a very simple model, similar to the one just described. If there is a contextual story with the problem, or if different parts of the problem are emphasized, this helps to "flesh out" and expand the model (Legrenzi, Girotto, & Johnson-Laird, 1993). Expansion of the model is based on internal logical rules, and, in this manner, the Mental Model theory is similar to the Mental Logic theory. If a problem requires the mental model to be significantly "fleshed out" before a solution can be reached, then it is more likely that reasoners will make errors rather than arrive at the correct solution.

Luckily, there are some inferences that are always modeled. For example, it is assumed that Modus Ponens is always modeled. "The mental model theory proposes that

[true antecedent and true consequent] is universally modeled — permitting Modus Ponens — but that Modus Tollens can only be achieved if the subject succeeds in "fleshing-out" the case [false antecedent and false consequent]" p. 1109 (J. S. Evans, Ellis, & Newstead, 1996).

Heuristic-analytic model

The final domain general theory that will be discussed is the Heuristic-Analytic Theory (J. S. Evans, 1984; J. St. Evans, 1993; J. S. Evans et al., 1993). According to this theory, there are two stages to the reasoning process:

1. Sub-conscious heuristics determine which parts of the model reasoners pay attention to, i.e. which parts they consider relevant.
2. The reasoner analyzes the relevant information that has been selected from stage 1 and reasons from it.

In addition, domain specific rules or heuristics are often used when the content of the problem is familiar. Namely, people will use a more powerful strategy if one is available to them. Evans gives two examples of heuristics that are often invoked when solving the WST. The first is an 'If-heuristic' that leads the reasoner to focus on true antecedents, regardless of any negations that may be present in the rule. The second is a 'Not-heuristic' that leads the reasoner to focus on affirmative cases when there are negatives present. These different theories can explain different patterns of participant responses on the WST. The If-heuristic can explain why "P" is chosen almost universally, while "not P" is almost never chosen. Matching bias (p. 7), it is argued, can be explained by the Not-heuristic.

However, according to the Heuristic-Analytical theory, the WST never gets past the first stage (J. S. Evans, Clibbens, & Rood, 1996; Roberts & Newton, 2001). In other words, they argue that the WST is not a reasoning task. Selection of all cards is determined on how relevant they look from stage 1. Thematic materials merely serve to make the correct choices appear more relevant.

Overall, each of these three theories believes that they can explain performance on the WST better than the other two. Even though they make different predictions, these theories share some similarities. For example, many different researchers have argued that there is not a substantive difference between Mental Logic Theory and the Mental Models theory (Lowe, 1993; Stenning & van Lambalgen, 2002). Klauer, Stahl, & Erdfelder (2007) argue that each of these theories is indicative of an Inference Model. They argue that participants tend to form a problem schema (mental model) and draw inferences from the story to make their choices. Similarly, Evans has tried to reconcile his Heuristic-Analytic theory with Johnson-Laird & Byrne's Mental Model theory by equating their notion of explicit representation with his notion of relevance (J. St. Evans, 1993; J. S. Evans et al., 1999; J. S. Evans et al., 1993). However, they still disagree on whether or not reasoning is involved in the WST. Klauer et al (2007) points out, "the inference model[5] has little chance of fitting real data, because some of the 16 possible patterns such as the partial insight pattern (1, 0 , 1, 1) [P, Q, and ~Q] should never arise according to the model" (p. 684). While Domain-general theories may have fallen out of favor, Domain specific theories have grown in number and variation. The next section describes the four main theories in this realm.

Domain Specific Theories

There are four types of domain specific theories, and they are all very different from one another. Some of them focus their attention exclusively on the thematic version of the task, while others emphasize both versions. The first two theories are Pragmatic Reasoning Schemas and Utility Theories. The last two theories are Social Contract Theory and Relevance Theory. Since these last two are directly relevant to the present study, arguments for and against each will be presented.

[5] Klauer et al (2007) is referring to all three of the domain general specific theories in this quote.

Pragmatic Reasoning Schemas Theory

Pragmatic Reasoning Schemas (PRS) theory[6] argues that people do not reason using logical rules; instead, they rely on generalizations from previous experiences to lead them to a solution. As Cheng & Holyoak (1985) put it: "people often reason using neither syntactic, context-free rules of inference, nor memory of specific experiences. Rather, they reason using abstract knowledge structures induced from ordinary life experiences, such as 'permissions', 'obligations', and 'causations'" (p. 395). These "knowledge structures" are pragmatic reasoning schemas. They have a single set of context-sensitive, yet generalized rules, which describe the relationship between the rules and the reasoner's goals. From these schemas, more formal logical rules can emerge (Chao & Cheng, 2000). As it applies to the WST, there are four different rules that the reasoner has in their pragmatic reasoning schema (Cheng & Holyoak, 1989):

> Rule 1. If the action is to be taken, then the precondition must be satisfied.
> Rule 2. If the action is not to be taken, then the precondition need not be satisfied.
> Rule 3. If the precondition is satisfied, then the action may be taken.
> Rule 4. If the precondition is not satisfied, then the action must not be taken. (p. 287).

These four rules cover both permissive ('may') and obligatory ('must') rules. The first rule allows the Modus Ponens inference to be made, whereas the fourth allows for Modus Tollens. Rules 2 and 3 are meant to block the inferences of Denying the Antecedent and Affirming the Consequent, respectively.

Cheng & Holyoak argue that the majority of WSTs use regulations schemas (schemas that govern behavior). Performance on the abstract version is generally very low, because there is not a pragmatic reasoning schema available to them. The abstract version of the task is novel and cannot trigger past memories or schemas. However, if

[6] PRS is considered by its authors to be domain general (P. W. Cheng & Holyoak, 1985). However, the literature often refers to this theory as being domain specific and the majority of the work on this theory has been done in the domain of the WST (Staller, Sloman, & Ben-Zeev, 2000). For this reason, it has been included in this section.

situations involving permissions or deontic conditionals (ex. “if P, then must have Q”) are used, participants will have experience with these sorts of problems, and performance will be facilitated (Cheng & Holyoak, 1989). Our everyday problem solving experiences can easily explain high performance on the thematic version of the task. Familiar context is almost certainly going to allow recall of experiences and their generalized schemas. Changing the wording of the context can emphasize different aspects of the schema. Because it is hard to determine what schemas a participant may already have or may develop during the course of the experiment, other researchers argue that there is not enough evidence to sustain this theory over others.

Utility theories

The second theory in the domain specific group is actually a small collection of theories. These are collectively termed Utility Theory. All of them are content independent and are based around the notion that probability and utility determine the participant’s behavior. The two primary theories are Subjective Expected Utility (Kirby, 1994; Oaksford & Chater, 1994) and Information Gain theory (Oaksford & Chater, 2001). The main difference between these two theories is that Oaksford & Chater (2001) argue for a Bayesian account of performance on the WST, whereas Kirby (1994) takes a much more subjective approach. However, since there is a substantial amount of overlap between the two theories, they are grouped under the larger term of Utility theory and their shared arguments are described below.

Utility theory was initially developed to explain performance on the WST. The theory rests on the notion that people do not reason in terms of logical rules or structures. Instead, people reason to achieve their goals. They examine their situation and subjectively determine what is important to them. The term subjective expected utility (SEU) is often used to describe the reasoner’s perceived utility of a given choice. Staller et al. (2000) formally defines it as, “the sum of the utilities of the possible outcomes, with each utility weighted by the subjective probability of that outcome” (p. 403). Because people often reason in terms of goals and utilities, it is unfair to argue that people are irrational based on the results from contrived problems. On the WST, people’s card

selections can be understood in terms of utility and optimal card selection, rather than in terms of logic. Participants will only choose to turn over a card if there is a high likelihood that it will have useful information. Of course, some researchers believe that pinning our hope on a reasoner's perception of subjective utility to explain performance on the WST is idealistic. First, it is difficult to predict ahead of time what a reasoner will understand as useful. Secondly, this group of theories still does not explain how the process's origins. The following section describes Social contract theory which attempts to resolve these issues.

Social Contract Theory

Cosmides proposed the Social Contract Theory in 1989. After describing the specifics of this theory, arguments for and against it will be presented.

Social Contract theory is probably the most specific and 'radical' theory of the seven. It argues, first and foremost, that humans have evolved a domain specific "cheater detection" algorithm that aids our performance in tasks involving social exchange (Cosmides & Tooby, 1992; Cosmides & Tooby, 1995). This cheater detection algorithm is necessary for social exchanges within a society and was created to solve "evolutionarily recurrent adaptive problems" (Cosmides & Tooby, 1992). For example, if you cannot tell when you have been cheated in a deal, you cannot take steps to either (1) rectify the situation or (2) make certain it does not happen again. Since it is necessary to be able to reliably tell when cheating has occurred, it is necessary, Cosmides argues, that cheater detection be an evolved mechanism (Cosmides, 1989). Therefore, any problem that triggers this mechanism should exhibit different patterns of behavior than problems that do not.

To understand fully what Cosmides means by "cheater detection", it is necessary to define a few key concepts: Theory of Mind and Social Exchange.

Theory of Mind is characterized by having the ability to understand the perspective of other individuals (Gopnik & Wellman, 1992; Happe, 1999). It allows us to predict what

others may do[7]. Having a Theory of Mind enables us to incorporate beliefs about another's actions into our reasoning about our own actions. Intentional cooperation, manipulation, cheating, and cheater detection all require a Theory of Mind. In other words, in order to identify those that are intentionally cheating you, you need to understand their potential motivations and intentions.

Cosmides (1989) defines a social exchange as "cooperation between two or more individuals for mutual benefit" (p.1). A social contract is then defined as a situation where Person A is obligated to satisfy a requirement (usually associated with a cost) to receive a benefit from Person B. Cheating is defined from the perspective of each of the parties involved in the exchange. So, cheating can occur when either (1) one member of the exchange or contract fails to pay the cost (or fails to meet the requirement) and gets a benefit or (2) one member of the exchange does pay the cost (or meets the requirement), but does not get the benefit. Therefore, to have successful social interactions, one needs to have a mechanism for social exchange and a mechanism for detecting when people are not following the rules (i.e. A Theory of Mind). Cosmides argues that both of these things are necessary for human survival within a cooperative society. Therefore, as they have evolved and adapted, so has "cheater detection."

Social Contract Theory has been the focus of a significant amount of research. It has been modified from its original version (described above), and the current theory of an evolved cheater "detection mechanism" has been joined by another theory of an "evolved hazard management system" (Fiddick, Cosmides, & Tooby, 2000). According to the "Hazard Management" theory, humans have evolved a domain specific mechanism for being able to reason about dangerous situations and precautions. Since these are different mechanisms, they argue that different problems that activate these different mechanisms will yield different patterns of results.

Social Contract theory argues that it can explain the behavioral results for both the abstract and thematic versions of the WST. The abstract version does not have any

[7] Theory of Mind has also been referred to as "mentalizing" (Frith & Frith, 2003) and as the "intentional stance" (Dennett, 1989).

resemblance to any 'real world' problems and, therefore, cannot trigger any of the mechanisms described above. Instead, reasoners have to rely on less powerful and more general reasoning strategies. The thematic version, on the other hand, often has a cost-benefit structure to it. This *automatically* evokes the "cheater detection" mechanism and is therefore facilitated.

There are four main arguments for Social Contract Theory (SCT). The first argument is that the addition of a cost-benefit structure to the WST facilitates high performance. The most well known study to argue this is Cosmides (1989). She ran three different experiments comparing six different types of stories with normal versus switched rules. The six story types were: (1) familiar social contract, (2) unfamiliar social contract, (3) unfamiliar descriptive, (4) familiar descriptive, (5) abstract, and (6) non-social contract permission rules. For the last story type, she also varied whether or not the context mentioned a social purpose.

Cosmides's main argument was that people look for instances in which a social contract has been violated. This involves checking for situations where the cost was not paid, but the benefit taken. On the normal version of the WST, these choices are confounded with the logically correct answers.

Switched rule versions, on the other hand, do not have this problem. For instance, in the following rule "If you watch the movie, then you must pay for it," both the logically correct answer and the SCT answer is to choose "watched the movie" (P) and "did not pay" (not Q). In the switched version of the rule, "If you paid for the movie, then you may watch it" the logically correct answer is "paid for the movie" (P) and "did not watch" (not Q). However, the SCT answer has not changed, it is still "watched the movie" (Q) and "did not pay" (not P), but now these choices map onto different logical components. By using switched versus normal rules, Cosmides rules out the possibility that cost-benefit information merely facilitates logical performance. She found that only social contract problems, regardless of whether they were familiar or not, showed evidence of facilitation.

Gigerenzer & Hug (1992) argue that a social contract alone will not improve participant performance. While cost-benefit information may be necessary for facilitation, it is not sufficient. They claim that the reasoner first has to be cued to look for someone who may be cheating them before facilitation can occur. They compared (1) social contract versus non social contract problems, (2) cheating information versus no cheating information, (3) switched versus normal rules, and (4) perspectives. They found a 33% improvement in performance for social contract plus cheater information problems when compared to social contract problems without cheater information (about 45% to 78%). In addition, they found no difference in performance on problems that did not have a social contract versus problems that had a social contract without cheater information. They argue that cheater information is needed, in addition to cost-benefit information, to improve performance.

Contrary to Gigerenzer & Hug (1992), but in partial support of Cosmides (1989), Platt & Griggs (1993) found that while "cheater detection" information may not be necessary, a social contract is. They studied the facilitative effects of different words and information in the WST. In four experiments, they tested five different features: (1) thematic versus abstract, (2) the addition or removal of cost-benefit information, (3) the addition or removal of cheater perspective information, (4) explicit versus implicit negatives, and (5) the addition or removal of the word "must". They found that, "When the cheating perspective, 'must', explicit negatives, and cost-benefit information were all removed, performance resembled that found with an abstract arbitrary rule (only 7% correct)" (p. 184). They concluded that cost-benefit structure was both necessary and sufficient for facilitation to occur (but that cheating information was not).

The second argument for SCT is that there is evidence for other domain specific, evolved mechanisms. Brown & Moore (2000) argue that, like cheater detection, altruist detection is an evolved mechanism. They compared altruism detection stories with cheater detection and abstract stories using both switched and normal rules. They found facilitation for both cheater detection and altruism detection stories (even though greater facilitation was found for cheater detection stories). They conclude that both altruist

detection and cheater detection are necessary for forming stable social structures and, therefore, they must both be evolved mechanisms.

Fiddick et al. (2000) also argues for another evolved mechanism besides cheater detection. They propose that there is an evolved hazard management system that governs how we reason about dangers. They compared hazard management stories to social contract stories and abstract stories, either using conditionals as the rule, or using non-logical descriptions such as "want" for the rule. This latter manipulation was done in response to arguments that the conditional form triggered a mechanism for reasoning about deontic conditionals rather than a cheater detection mechanism. They compared the rule "If P then Q" to rules like "Person A, who has Y, wants X, Person B, who has X, wants Y". They argued that the latter version would not elicit mechanisms for deontic reasoning, but would still elicit social exchange mechanisms (if one party gives up what they have without receiving something in return).

By comparing a hazard management story to a nearly identical social exchange version, they directly tested their prediction that these two things involve different mechanisms. They predicted that the different types of stories would elicit opposite patterns of results. They found no significant difference between the "want" versus standard conditional rules. They did find a significant difference between their two types of stories, however. Both stories showed significant facilitative effects for performance in the predicted directions. They argue that the results support two main conclusions: (1) deontic conditionals are not necessary to facilitate performance on social contract or hazard management problems and (2) domain specific inferential mechanisms will preempt the use of domain general comprehension mechanisms. This latter argument has been termed "pre-emptive specificity" (Fiddick et al, 2000).

Sugiyama, Tooby, & Cosmides (2002) used a more direct measure to determine whether the mechanisms proposed by SCT are evolved or not. If a mechanism has evolved, then it should exist in every human, regardless of age or culture. To test this, they did a cross-cultural study and tested Shiwiar[8] participants on the WST. They compared performance on cost-benefit problems to performance on descriptive and

[8] The Shiwiar tribe is located in the Ecuadorian Amazon

abstract problems. When looking at logical performance, they found substantial facilitation for cost-benefit problems. In addition, when looking at individual card selection frequencies, the Shiwiar participants had performance rates similar to those of Harvard undergraduates. They conclude that the domain specific mechanisms hypothesized by SCT have evolved.

Finally, the last argument for SCT is that there is evidence of a neurological disassociation. Stone et al. (2002) conducted a behavioral study comparing performance on different versions of the WST between a lesion patient (RM), brain damaged controls, and normal controls. RM has bilateral damage to the medial orbitofrontal cortex and to the anterior temporal cortex. The damage is so extensive that it has disconnected the right and left sides of the amygdala. Stone et al. predicted that RM would perform significantly worse on social contract problems as compared to hazard management problems and compared to both brain damaged and normal controls, because he has significantly impaired social intelligence. If social exchange reasoning is a specialized mechanism distinct from hazard management, then his performance should only be harmed for social contract problems.

RM's performance was 70% for hazard management problems versus 38.9% for social contract problems. For both brain-damaged and normal controls, this difference was, on average, less than 1.2%. From this they conclude that RM provides evidence of a disassociation between the Cheater Detection and Hazard Management mechanisms of reasoning. They also predict that a patient with damage to the medial frontal or anterior cingulate might provide evidence for a double disassociation.

There are two other minor studies that argue for SCT based on different materials effects. First, Grams, Finch, & Sheu (1995) found facilitation for social contract stories when compared to abstract stories (even though all performance levels were much lower than what Cosmides found). Second, Beaman (2002) tested the facilitative effect of using the word "required" in front of the rule in the WST. This was in response to Fodor (2000) who argued that the facilitative effect for social contract problems was because participants were reading the thematic conditional as if it had the word "required" and were reading abstract conditionals the way they were written. Beaman tested this theory

and still found facilitory effects for social contract problems (even though adding the word "required" did improve performance for both types of stories).

There are three main arguments *against* SCT. The first is that facilitation has been found on the WST without involving a cost-benefit structure. Cheng & Holyoak (1989), described in more detail in Appendix B (p. 105), tested abstract stories versus thematic stories involving pragmatic reasoning schemas. None of the thematic stories involved a social contract, yet substantial facilitation was shown.

The second argument against SCT is that the facilitation found for SCT stories is due entirely to a materials effect. Fiedler & Hertel (1994) manipulated whether rule violations were mentioned, whether participants were given falsification or verification instructions, and whether or not the situation described by the story was deemed important. He found no effect of the importance condition, but did find that when rule violations were mentioned, and participants were instructed to find out which cards falsified the rule, performance was identical to performance on social contract problems. He concludes that the facilitative effect that is often found is not due to the social contract, but to how the task refocuses the participants' attention through framing.

Similarly, Liberman & Klar (1996) argue that performance on social contract tasks can be explained by three features: "(1) The clarity of the rule in terms of determination and direction; (2) the nature of the alternative to the tested rule and the falsifying instance it entails; (3) the perceived relevance of looking for violation strategy" (p. 127). To illustrate this, they tested participants on four types of stories (taken from Gigerenzer & Hug, 1992): (1) the original cheating story, (2) a modified cheating story, (3) the original non-cheating version of the story, and (4) a modified non-cheating version of the story.

The stories were modified in two ways. First, they removed facilitative features from the cheating version and added it into the non-cheating version. Second, they removed the alternative explanation and probabilistic terms from the non-cheating version. They argued that these modifications would remove the facilitative effects. What they found is that participants solving the unmodified cheater story had the same performance as those

solving the modified non-cheater story. Performance on the modified cheater version was also the same as performance on the unmodified non-cheater version. In addition, they found that, when both violations were mentioned from the context of each perspective, facilitative perspective effects disappeared. They conclude that cheater detection information is not necessary for facilitation (they argue that Gigerenzer & Hug (1992) had confounded materials).

Three other studies had results similar to the ones above. They are Ahn & Graham (1999) described in more detail in Appendix C (p. 997), Almor & Sloman (2000) described in more detail (p. 30) when we discuss Relevance theory, and Sperber et al. (1995) also described in more detail when we discuss Relevance theory (p. 29).

The final argument against SCT is that they are not testing reasoning from evolved mechanisms using the WST. Sperber & Girotto (2002) make an argument that is similar to the ones above, but they take it one step further: they argue that the standard WST and the version of the WST used by other experimenters (such as Fiddick et al, 2000) are two separate tasks. The first may be a task of reasoning, but it is also a task of relevance. The second is a task of categorization and not reasoning. In two different experiments, they compared the cost-benefit version of the WST to two WST-like tasks that involved either a meaningful categorization or an abstract categorization. They instructed participants either to look for cheaters or to look for exchanges. They predicted that there would be higher rates of "P" and "Q" in the exchange version because participants were not reasoning about the problem; they are just categorizing things in the requested manner.

In direct opposition to SCT's predictions, they found that performance was best for the abstract categorization version and lowest for the cost-benefit version. In line with their own predictions, they found higher rates of "P" and "Q" in the exchange version. From these results, they draw three conclusions. First, the results from Fiddick et al (2000) are flawed, because they were not asking participants to reason on the WST, they are asking them to categorize cheaters. Second, people do not automatically look for cheaters (it is not an innate mechanism), they just do what they are asked to do. Third,

even if SCT is valid, using the WST to prove it, is not. This argument against the SCT led to the creation of Relevance theory, which is described next.

Relevance theory

The last of the seven theories concerning the WST is Relevance Theory (D. Sperber et al., 1995). Relevance Theory argues that, when we are communicating with others, we need to determine what aspects of the discourse are relevant. The mechanism for determining relevance has three general features. First, it is domain specific; this domain is discourse comprehension. Second, it is not content specific; these mechanisms can apply to anything that can be described as communication. Finally, since these mechanisms determine relevance, they must also be used to determine intention. Therefore, they argue, these relevance mechanisms are evolved (similar to Cosmides) and comprise a sub-unit of the Theory of Mind mechanism.

Sperber et al. (1995) argues that the WST is both a reasoning and discourse comprehension task. As such, reasoners go through three stages when solving the WST:

1. Reasoners infer the consequences (conclusion) from the rule given in the problem. However, these consequences are inferred from easiest to hardest in an attempt to minimize cognitive effort while maximizing the relevance of their conclusion.
2. When participants reach a conclusion that they deem to be relevant, they stop inferring for more, instead they satisfice.
3. They test their conclusion based on what they have previously inferred.

Because of these three stages, reasoners make their card choices based on what they perceive to be a valid conclusion. They do not look at the cards first and then decide what to infer. Relevance Theory argues that, the WST cannot be a pure test of reasoning because it is so heavily dependent on discourse comprehension and relevance mechanisms. Mechanisms for determining relevance and the mechanisms for reasoning are confounded in the WST. Therefore, they argue, it should be abandoned as a test of reasoning, and research involving the WST should cease.

To support their claims, they make two predictions concerning WST performance. First, they state that how the rule is interpreted and expressed should determine what the reader deems as relevant. Therefore, changing the expression of the rule should change performance. Second, they state that if simple wording changes are made to decrease cognitive effort, performance should increase. For example, using lexicalized phrases rather than unlexicalized phrases ("unmarried versus "not married") should improve participant performance.

The majority of the research in support of the Relevance Theory (RT) has made one main argument: linguistic features are the cause for facilitation on the WST. Sperber et al. (1995) was the first to advance this argument (at least as it pertains to RT). She argued that there is a very simple "recipe" for making an easy selection task: (1) "Select a pair of simple features P and Q such that the complex feature *P-and-(not-Q)* is, or can be made, easier to represent than the complex feature *P-and-Q*", (2) "Create a context where knowing whether there are *P-and-(not-Q)* cases would have greater cognitive effects than knowing whether there are *P-and-Q* cases", and (3) "Present the rule 'if P, then Q' in a pragmatically felicitous manner" (p. 59). They argue that, by following this recipe, one can create versions of the WST that are highly facilitory and do not fall under any of the categories of previous theories, such as permission rules or social contracts.

Over the course of four experiments, Sperber et al. compared a 'recipe' version of the WST to the abstract version. They manipulated whether the stories were seen as relevant or irrelevant, having a large effect versus a small effect, and as requiring a lot of effort versus little effort to solve. They predicted that performance would be higher on high effect and low effort conditions, and that performance would be lowest on low effect and high effort conditions.

All of the results supported their predictions: (1) performance was higher on the recipe version than on the abstract, (2) relevant stories had better performance than irrelevant stories (the irrelevant stories also had high rates of matching), and (3) performance was best for large effect and low effort (57%) and lowest for small effect and large effort (5%).

They formed four different conclusions from their results. First, they argued that participants do think through the task as they are solving it. They argued that participants imagine testing the rule. Second, participants' selections are chosen based on the features of the cards. They pick cards that are both relevant and that minimize effort while maximizing the effect of their choice (similarly to utility theories). Third, previous experiments using deontic versus abstract tasks were testing two different tasks rather than two different versions of the same task. Lastly, they concluded that since facilitation has been found on descriptive tasks (which are harder to solve), then facilitation should occur on deontic tasks as well. Therefore, previous experiments have had relevance aspects confounded with their results.

Almor & Sloman (2000) come to similar results as Sperber et al. (1995), but by using a different method. They asked participants to do three different tasks: the WST, a rating task of how probable the story was, and a recall task of the rule they had seen. First, they found that rule recall was unaffected by the task. Therefore, they concluded that the underlying representation of the problem was the same for the WST (a supposed reasoning task) as it was for a linguistic judgement task (reading the story and rating how probable they thought it was). Second, they found that the recalled rule was a better predictor of card selection than the actual rule, itself. They concluded that domain specific explanations of performance on the WST are unnecessary; all performance is explainable by linguistic factors.

More recently, Carlisle & Shafir (2005) compared participant performance on cheater detection (CD) stories to ones that had all references to cheaters removed (non-CD). Unlike previous studies, they added extra information to the instructions that followed the stories. For the CD stories they added extra information highlighting the need to catch the cheater and for non-CD stories they added information that encouraged a different explanation for the rule they were being asked to judge. For example, their instructions for Cosmides's 'eggshell in exchange for duiker meat' story added the line "Did Bo get away with cheating any of these four men?" (p. 114). The non-CD version of this problem had the added instructions "Your job is to make sure each hunter is properly prepared for his hunt" (p. 122). Over their three experiments, they found that

accuracy on the non-CD problems came close to accuracy on the CD problems. They conclude that Cosmides' Cheater Detection theory cannot account for the increased performance they found when adding "relevance cues" to the stories.

There are two main arguments against RT. The first is that the WST is a task that involves reasoning about more than just discourse. Logical reasoning is evident when misunderstandings concerning the problem structure are resolved. Ahn & Graham (1999), described in more detail in Appendix C (p. 997), varied the lexicality of their "not Q" cards in their first experiment. According to RT, by lexicalizing terms, cognitive effort is decreased so performance should increase. However, they found that lexicalizing terms had no effect on performance. In fact, in one of their conditions, lexicality was associated with poorer performance. They concluded that, when necessity-sufficiency relations are made clear, lexicality and cognitive effort do not matter. Furthermore, they argued that performance on the WST does involve reasoning, and previous reports of poor performance are due to participants not fully understanding the problem.

The second argument is that, contrary to RT, deontic and descriptive rules use different processes. Fiddick et al. (2000), described in more detail previously (p. 24), tested two predictions from RT. The first prediction from RT is that, when the rule is not expressed or interpreted as a denial or prohibition, the high levels of "P" and "not Q" responses should disappear. However, Fiddick et al. found that removing the logical connectives from a problem, so that the deontic interpretation is blocked, did *not* decrease rates of "P" and "not Q" responses on social contract problems.

Second, RT predicts that problems involving a precaution should be interpreted in the same way as a descriptive or social contract problem. However, precaution problems had significantly higher accuracy scores than the description problems, even though both had the same, non-deontic, linguistic form. RT theory assumes that deontic and descriptive rules use the same cognitive processes (the processes for discourse comprehension). This assumption means that RT cannot explain (1) how different versions of deontic tasks, like cheater versus non-cheater, elicit different patterns of results, and (2) why the same rule with different perspectives elicits different patterns of

results. In addition, they argue that RT cannot account for the differing selection patterns on precaution rules versus social contract rules.

As different as all of these domain specific theories are from each other, they do share some similarities. Both Pragmatic Reasoning Schemas theory and Social Contract theory argue that content specific rules for reasoning come before content general rules. They also both agree that all social contract rules fall under the category of permission rules, but that not all permission rules are social contract rules. Pragmatic Reasoning Schemas theory, Social Contract theory, and Utility theory argue that the WST can give us valuable insights to the underlying processes of how reasoning actually occurs, whereas Relevance theory believes that reasoning and relevance on the WST are irrevocably confounded.

Now that there is a basic understanding of the WST, its findings, and the many competing theories, we can proceed to examine the task, and this study, in greater detail. Chapter Two will discuss how WSTs are commonly created and, specifically, how they were formed for use in this study. Chapter Three will take the physiological predictions that are made by both SCT and RT and look at related research in similar fields. This chapter will focus on physiological research in areas of emotional reasoning and Theory of Mind.

Chapter 4 will use the research presented in the previous three chapters to describe the logic behind the three experiments that were conducted and our expected results. Chapter Five is where all three experiments and their results are discussed. Finally, in Chapter 6, we will discuss what can be learned from the study and future directions for research.

Chapter Two: Construction of the Wason Selection Task

With all of the history surrounding the Wason Selection Task, it is no wonder that so much research has been focused on how it is constructed and which features contribute to which effects. The first part of this chapter will describe the four different components of the WST: the cards, the rule, the instructions, and the story. This section will also discuss the research that has gone into teasing out the significant aspects of each part. The second part of this chapter will use the research described previously to explain the procedure used for the present study.

1 Components of the Wason Selection Task

Every Wason task has four components:

- The cards that the participant must choose from,
- The rule that they are reasoning from,
- The instructions that they are given, and
- The story that provides the context and framing for the task as a whole.

The Cards

Theorists tested two main variations on the card choices of the WST: explicit negatives and lexicalization. The first major experiment to analyze the effects of explicit negatives was Evans (1993) when he was exploring the requirement for matching bias (p. 22). He provided a rule like "If the person is drinking beer then they are over 18." Then he compared participant performance for implicit negatives (e.g. "drinking coke", "25") against explicit negatives (e.g. "Not drinking beer", "not over 18"). By using a rotating negatives paradigm where both the rule and the card choices could have a negative or not, he found that explicit negatives in card choices increased the likelihood of matching bias (for more information see the full description of the study in Appendix B). However, the increase in matching bias was not linked to an increase or decrease in logical performance.

Similarly, lexicalization has been studied as a way to improve participant performance through modifying the nature of the card choices. Sperber (1995) argued that lexicalization (using the phrase "unmarried" vs. "not married") increased participant performance. Ahn & Graham (1999), however, found that when conditions of necessity and sufficiency were made explicit (in other areas of the task like the story or the instructions) the lexicality of the cards made no difference to participants.

Since, the text of the card choices are fairly limited on the WST, not much can be done to change their format. Changes are often overshadowed by other features of the task. For this reason, the current study chose to lexicalize card choices where possible and to let the context of the story and the rules determine if negatives were explicit. Given the lukewarm nature of the research on card choices, ease of understanding and textual flow were considered to be more important to the structure of this experiment.

The Rule

Unlike the cards, the structure of the rule is one of the most contested aspects of the WST. In general, the structure of the rule can significantly influence how a participants' mental model of the problem is framed and determines the sort of reasoning used.

Much of the past research on rule form for the WST has been focused on whether or not a deontic rule is necessary, sufficient, or even the same task, as WSTs without a deontic rule. Generally speaking, deontic rules are obligation rules, such as "If there is a vowel on one side, then there *must* be an even number on the other" or "If they watch the movie, then they are *required* to pay $4.00". Permission rules, on the other hand, do not emphasize a forced choice. For example, "if they are over 18, then they *may* drink beer". In this situation, the cards may not represent a closed set, so a 'true' answer is harder to argue.

Regardless of what the rule says, participants may interpret it in different ways. For example, Fodor (2000) argues that the word '*required*' is necessary for a participant to view the card choices as a closed set. Griggs & Cox (1982) and Chen & Holyoak (1989) found that using the word "must", as compared to "may", facilitated participant

performance. Fiddick et al (2000) and Beaman (2002), on the other hand, found that deontic terms were not necessary as long as the story and instructions were framed properly.

On the most extreme end, Sperber (1995) and Relevance Theory argue that WSTs with deontic conditionals are fundamentally different from WSTs that lack this element. They argue that deontic conditionals trigger a reasoning set that is substantially different from the "cheater detection" algorithm of Cosmides's SCT. Now while SCT has certainly found facilitation using deontic conditionals, they have also found results without them.

The research on deontic conditionals is inconclusive as to their effects and the mere fact that it is called out as a substantial materials problem by Sperber means that deontic conditionals were not used in this study.

The second controversial aspect of the rule form is whether it is 'switched'. For example, the switched version of the rule "If the person is drinking beer, then they are over 18" would look like this: "if the person is over 18, then they drink beer". Many of the domain-general theories for the WST argue that participant facilitation is based on some form of logical reasoning (be it through mental model representation or the selection of appropriate heuristics). The switched rule form is a method for differentiating logical reasoning from any form of social contract reasoning that may be present in solving the WST (Cosmides, 1989). In the example above, the logically correct answers (P: beer and ~Q: not over 18) are mapped to the social contract answers (Gets the benefit: beer, does not meet the requirement: not over 18). In the switched form of the rule, however, the social contract answers stay the same, while the logically correct answers switch. With the rule "If they are over 18, then they drink beer", the logically correct answers become "Over 18" (P) and "not drinking beer" (~Q), while the social contract answers are still "drinking beer" (Gets the benefit) and "not over 18" (has not met the requirement). Cosmides used this normal rule-switched rule paradigm to show that the reasoning processes that are involved with solving thematic, "cheater

detection" WSTs are significantly different from the reasoning that goes into solving abstract versions of the task.

Since, Social contract is one of the main theories under investigation in this study, all tasks used the normal rule-switched rule paradigm.

The Instructions

The instructions of the WST serve as the framing mechanism for the participant's understanding of the problem. Originally, the instructions were straightforward, asking participants to determine "if the rule was true" or "if the rule was true or false". As early as 1982, Griggs & Cox found that when the instructions asked people to look for rule violations, performance was significantly higher than when they were just asked to determine the rule's veracity. They argued that this was because participant's are cued to use a detective set which helps them to look for counterexamples to the rule. Fiedler & Hertel (1994) found similar facilitation rates for thematic WSTs when participants looked for violations of the rule, but they argued that it was due to a more effective framing strategy as evidenced by the increased facilitation for abstract WSTs, as well.

The two theories being examined in this study fall into each category. Social contract theory argues that as participants look for violations, a "cheater detection" mechanism is cued, allowing participants to effectively reason through the problem. Relevance theory, on the other hand, argues that looking for violators merely change the participants' framing of the situation by making counterexamples more relevant. Since both theories believe that falsification instructions facilitate performance in ways that are consistent with their own theories, all WSTs in this study used falsification instructions.

The Story

The story portion of the WST has received the greatest attention. From the initial abstract task created by Wason, to the familiar and unfamiliar tasks created by Griggs & Cox and Wason & Johnson-Laird, the story components, features, and content matter, have been modified and studied.

As stated in Chapter 1, the main contention for Social contract theory is whether participant facilitation is determined by (1) cost-benefit information, (2) "cheater-detection" information, or (3) social contract information. Cosmides (1989) argues that the WST story needs to have a cost-benefit structure to be able to trigger the "cheater-detection" reasoning mechanism in participants. Platt & Griggs (1993) did a more extensive analysis of cost-benefit information, cheater detection cues, and explicit negatives, and found that cost-benefit information is both necessary and sufficient for performance improvement. Lieberman & Klaus (1996) found similar results, but emphasized that it had to be within a social contract situation. On the other hand, Gigerenzer & Hug (1992) compared stories that varied whether or not cost-benefit information was mentioned, as well as whether or not cheater detection was emphasized. They found that only "cheater detection" information was necessary for facilitation.

Relevance theory simply argues that all of the above information is unnecessary as long as the story is written in such a way as to make the desired categories (e.g. cheaters) more relevant to the reader (see RT recipe, p. 26). Sperber (1995) argues that the WST confounds actual reasoning with categorization processes. Because of this, the stories in this study all have cost-benefit information, social contract aspects, *and* cheater detection information. According to SCT, this format is most likely to trigger the cheater detection reasoning processes, and according to RT, this format is most likely to make the category of cheaters more relevant to the reader. In either case, this should lead to improved performance.

2 The Current Process

The process for creating the materials for this study was twofold. First, materials from previous research was gathered and, second, new materials were created to match the previous materials.

Of the four components of the WST, only the last three components (rules, instructions, and story) were modified when the previous materials were pulled into this

study. For all tasks, any explicit reference to deontic or permissive conditionals (must, may, required) was removed from the rules. For example, "If there is a vowel on one side, then there must be an even number on the other" was changed to "If there is a vowel on one side, then there is an even number on the other". In addition, each rule was paired with a switched version. Therefore, using the example above, the switched rule would be, "If there is an even number on one side, then there is a vowel on the other". Both abstract and thematic WSTs had a normal rule and a switched rule.

The vast majority of the instructions on the previous materials were shortened so that they were a uniform length and structure (many of the abstract instructions were lengthened a bit). In the first stage of this study, all instructions (for both thematic and abstract) ended with "Indicate only those card(s) you definitely need to turn over to see if any of these people are violating the rule." The two key features of the instructions were the term "card(s)", to indicate that more than one choice is possible, and the explicit instruction to look for violators of the rule. In the second half of the study, the format was near identical, except that the term "violating" was sometimes replaced with "breaking", "lying", "cheated" etc, depending on the context of the story.

Finally, most stories from previous materials were modified for length and content. Many of the thematic stories were shortened while the abstract ones were made longer. The content changes were made so that social contract information, cost-benefit structures, and cheater perspectives were highlighted and made more explicit and relevant to the story.

The above changes formed a stable set of previously tested materials that were used to guide the creation of the new tasks. Three things needed to be created: New abstract WSTs, new thematic WSTs, and new comprehension stories to compare to the thematic WSTs. First, the abstract stories were nearly identical in form and wording to the originals. For example, instead of asking about letters and numbers, some tasks asked about shapes and colors. All new abstract tasks included the instruction to look for violations of the rule.

Secondly, new thematic tasks were developed. Instructions were taken near verbatim from previous tasks as were the format of the rules and the card choices that were available. The stories had to be similar to previous, but on a different topic. The template for the new stories was divided into four parts. First, each story gave a brief description of the context and the rule to be enforced. Second, each story had a rationale for why (and how) people break the rule (to cue relevance to the cheater category and to trigger any cheater detection mechanisms). Third, the story specified the participant's role – to catch cheaters. Finally, the story introduced the potential punishment for failure. See table 2 for an example of familiar thematic and unfamiliar thematic.

Template Stage	Example of Familiar Thematic	Example of Unfamiliar Thematic
Description of context and rule	You are one of Santa's elves. Santa is getting old and can no longer keep track of all the children in the world. He has developed a new method to determine which children should get presents in their stockings and which children should get coal: Instead of checking his list, he now just asks the children to write down on the top of their wish list whether they have been naughty or nice.	You are a member of a hidden mermaid and mermen civilization that lives deep beneath the Pacific Ocean. Your entire civilization is vegetarian, so you only eat the algae that float along the surface. The merpeople are afraid that humans will discover them and put them on display in a zoo, so they live their lives in secret and are very cautious when going up to the surface to harvest algae. All merpeople that are involved in the harvest are required to complete an ocean surface safety course and obtain a harvesting license before they are allowed to go within 300 feet of the surface.
Why/how people break the rule	However, he now believes that some of the children may have lied and put nice on the top of their wish list just to get presents!	However, a group of merpeople has recently been traveling near the surface to try to get a glimpse of a human and doing so without licenses.
Participant's role	Santa has given you the job of making sure that none of the children are lying. Your plan is to ask the children's parents whether their kids have been naughty or nice, and then find out whether or not they received presents	Your queen has ordered you to patrol the surface to make sure that any merperson that is closer than 300 feet of the surface has completed the surface safety course.
Punishment	. It is important that you fulfill your role or Santa might get a new elf to do your job. You would then be demoted back into the toyshop, which has long hours and no health care!	If fail at your task your civilization may be found.

Table 2: Examples of Story Creation Process: Wason Selection Task

This template guided the creation of all new stories created for this study. In addition, stories from previous studies were compared to the template to ensure that all stories were as similar in form as possible.

Finally, comprehension stories based on the thematic WSTs were developed. All of these stories were new and all of them matched the context of an existing WST. Like the WST, each of the comprehension stories was based on a template. The template for comprehension stories had three parts: 1. a description of an unfortunate situation (that

referred to the rule given in the WST version), 2. An example of the rule violation (from the matched WST version), and 3. A behavioral change for the main character. See table 3 for the comprehension stories that are matched to the WST stories in table 2.

Template	Familiar Comprehension Story	Unfamiliar Comprehension Story
Unfortunate situation	It's true: Santa Claus is getting old. He notices every year that his cheeks are getting a little less rosy and his bones have been starting to ache when he climbs down a chimney. This year, Santa decided to do something about it, so he called a board meeting with his top executive elves to brainstorm about the holiday plan of action.	Jane is a mermaid. Life in the deep Atlantic is pretty easy: the weather's always the same, coral hut to live in, and there's free shellfish 24 hours a day! There was just one rule Jane had to obey: stay away from the surface. The creatures that inhabit the world above are killing machines that will gleefully harpoon anything that crosses their path.
Violation of Rule	Then, the lights dimmed and the presentation began. Santa couldn't believe what he was hearing! The ideas all seemed to involve some kind of fake Santa taking over his duties: robot Santas, ninja Santas, even an army of atomic mutant Santas! What would the little children think if they woke up in the night and saw a mutant Santa stuffing their stockings?	However, Jane used to play around in a sunken ship when she was little, and she couldn't imagine how such demons could have created the things of beauty she found there. She knew that, if she could just get to the surface, she could prove that the humans were not demons. The problem was that it was a long trek up to the surface and, if anyone realized she was gone, they would come after her. Then, she thought of a great idea: She would drag the wooden mermaid from the sunken ship up to the top of the coral reef and make it look like she was up there catching some rays!
Behavioral change/Resolution	Old St. Nick just got up out of his chair and, without uttering a word, he walked out of the boardroom. Over the next six months, he joined a gym, got a personal trainer, and by the time December rolled around, he was stronger than any ninja imposter could ever be!	It worked like a charm, too. When the other mermaids finally discovered the deception, search parties were sent out in every direction, but no sign of Jane was ever found. They turned the statue into a memorial and now, whenever mermaids and mermen tell their merchildren not to swim near the surface, they always end with 'or you'll end up harpooned and eaten, like poor aunt Jane!'

Table 3: Examples of the Story Creation Process: Comprehension Task

Just as every WST is followed by a task or set of tasks that the participant is asked to solve, each of the comprehension stories preceded a set of multiple choice questions related to the story. Each of the questions related to one of the key features in the story and participants were instructed to select the "best answer or answers".

The above process led to 16 abstract WSTs, 32 thematic WSTs with 32 matched comprehension stories.

Relevance theory argues that the WST confounds reasoning with relevancy categorization while Social contract theory argues that a special type of non-logical reasoning is used in the WST to catch cheaters. The above process will allow a comparison between WSTs and comprehension stories that share the same level of relevance information. If there is any reasoning beyond relevance categorization, it will be evident in the comparison of these two tasks. In the next chapter, both the SCT and RT are examined for what type of cognitive process is going on in the WST. SCT argues for an emotional-based, cheater detection type of reasoning, while RT argues for discourse comprehension and more general processes related to the Theory of Mind. After related physiological research on emotional reasoning and theory of mind is discussed, the chosen stratagem for the current study will be explained.

Chapter Three: Bridging the Gap

Even with materials that all sides can agree upon, there still remains two questions: "What are we trying to measure?" and "How are we going to do so?". To answer these two questions this chapter will first compare Social contract theory with Relevance theory to better understand what each claims the Wason Selection task involves. Then, the chapter will examine the different methods for measurement.

1 What is Being Measured?

At its most basic level, SCT argues that the WST involves specialized mechanisms for reasoning while RT argues that participants use discourse comprehension. For SCT, Cosmides (1989) argues that participants reason on the thematic WST by using an evolved "cheater detection" mechanism that developed based on the complexity of social contracts in early human interaction. Fiddick et al (2000) argue that reasoning triggered from this evolved mechanism is used *before* more generalized forms of reasoning. Termed "pre-emptive specificity", this argues that more specialized processes are always tried before more generalized ones.

Fiddick et al (2000) argues that another example of a specialized process that preempts generalized reasoning, is Hazard Management. This mechanism is used for reasoning in situations that weigh potential benefits with potential risks of bodily harm. Together, "hazard management" and "cheater detection" form a paired specialized reasoning process that enable humans to function in a dynamic and often dangerous environment. Fiddick et al argue, and have found partial evidence for, a double disassociation between these two processes. As described in chapter 1, Stone et al (2002) compared performance on different versions of the WST between a lesion patient (RM), brain damaged controls, and normal controls. They found that RM's damage to the medial orbitofrontal cortex and to the anterior temporal cortex significantly impaired his performance on Social contract versions of the WST (when compared to normal participants), but did *not* affect his performance on hazard management problems.

Outside of the lab, reasoning is often affected by more than just logic. A number of different branches of research (behavioral, neurological, physiological) have shown that reasoning performance can be improved by adding an emotional context to the problem (e.g. Damasio, 1994; Houde et al., 2001; Houde et al., 2000). In addition, this facilitation of performance has been associated with a greater physiological response and greater activation in the ventromedial prefrontal cortex (VMPFC).

Lesion studies on patients with VMPFC damage have found similar results. Bechara found that patients with VMPFC lesions consistently make disadvantageous choices in a gambling task (e.g. Bechara, 2003; Bechara, Damasio, Damasio, & Anderson, 1994; Bechara et al., 2000; Bechara, Damasio, Damasio, & Lee, 1999). In a study comparing patients with VMPFC damage to patients with amygdala damage and normal subjects, he found that normal subjects showed greater skin conductance responses, both before selecting cards and after receiving a reward or punishment. Amygdala damaged patients did not show an increased skin conductance response at either point. Like the normal subjects, VMPFC patients showed greater skin conductance responses to punishments and rewards. However, like the amygdala-damaged patients, they showed no skin conductance response to the selection of cards. This indicates that the function of the VMPFC is to allow participants to take into account future consequences when making decisions. Theorists argue that the VMPFC is responsible for integrating emotions into reasoning e.g. (Bechara et al., 2000; Damasio, 1996; Houde et al., 2001).

In Cosmides (1989) paper, she argues that when participants are solving the WST, they are not reasoning "logically", according to Goel & Dolan's (2003) definition of reasoning. Instead, they are reasoning using an evolved mechanism that is often associated with emotion (no one wants to be cheated and it is something that we try to avoid at all costs). In the Stone et al. (2002) study (described previously p. 25) the bilateral orbitofrontal cortex and the amygdala were both associated with decreased performance on social contract versions of the WST. Based on this study and the research done by Bechara and Houde, if reasoning is involved with solving the WST (as opposed

to discourse comprehension alone), then participants should exhibit different physiological and neurological responses when solving a WST versus reading a story.

According to RT, all of the above is unrelated to the WST. Sperber, Cara, & Girotto (1995), argue that participants solve thematic WSTs the same way that they understand any other social situation: by using discourse comprehension. Discourse comprehension is a far more generalized process. But, like "cheater detection", it is related to Theory of Mind.

2 Methods of Measurement

There are many different ways to gain insight into the cognitive processes that someone goes through when making a decision. Eye tracking research can help us learn what a participant finds salient, either consciously or unconsciously. PET scans and fMRIs can be used to determine which parts of the brain need more oxygenated blood. EEGs can measure the slight electrical impulses that come from neuronal activation. GSRs can help us determine the visceral changes that come from participant's autonomic responses.

Galvanic skin response (GSR) is also known as skin conductance response (SCR) and electrodermal response (EDR). Phasic skin conductance is the measurement of GSRs around a particular event or cognitive trigger. A person's GSR amplitude leading up to the trigger can provide insight into their thought processes or underlying emotions leading up to the event (anticipatory processes) and the maximum peak (generally occurs between 900ms and 4000ms after the trigger) is indicative of the participant's cognitions concerning the consequences of the event.

In addition to being able to provide physiological information leading up to, and following, a given trigger, GSR has the unique characteristic of being low-cost and low-effort when compared to other physiological measures. For example, fMRIs and EEGs require participants to commit to a significantly higher level of effort to the experiment

(long periods of lying very still in a tube and electrode caps versus three surface electrodes).

While other neurological measures definitely provide information that GSR experiments cannot, GSR is well suited for an initial analysis of a topic to determine if more extensive physiological measurements will prove fruitful. In this particular instance, we are trying to determine whether or not emotional reasoning is involved in the WST versus a more general discourse comprehension. Given the large amount of GSR research on the topic of emotional decision making, this method will be especially useful in determining the underlying processes in the WST. Naqvi & Bechara (2006) stated:

> Skin conductance response has offered a unique window into the mental processes that represent the value of goals and outcomes. The measurement of skin conductance response has provided support for the somatic marker hypothesis of decision making, which holds that emotions, in particular the visceral manifestations of emotions are critical components of the process of decision making under conditions of uncertain risk and reward (p. 113).

Physiological studies may be able to provide a more detailed examination of the task than behavioral studies can obtain. Each of the described theories make very specific predictions about how reasoners go about solving the WST, and these different strategies can be linked to different physiological patterns and different areas of the brain. By investigating the physiological patterns of participants performing the task, researchers could determine: (1) Whether or not the different versions of the task use the same strategy, or (2) What sorts of strategies participants are actually using. Since behavioral studies have found it very difficult to differentiate between reasoning and comprehension, especially when one of the main arguments is over which comes first, investigating the time course of physiological measures may provide us with the missing information that we need.

If this study finds support for SCT, it will spur research on different reasoning modules rather than domain general mechanisms. On the other hand, if Relevance theory is supported, research on the WST could come to a screeching halt. This is not to say that

research on reasoning would stop, just that researchers may be better served by using a different task in their studies.

In the next chapter, all of the past research on the WST, the process used to create WSTs, and the related research in physiological realms is pulled together to explain the logic behind the current study. This will provide a background upon which the story of the study can be told.

Chapter Four: The Plan

1 The Story

So, what sorts of cognitive processes go through a person's head when they are trying to solve a thematic WST? SCT theorizes that an emotional based reasoning, arising from the ventromedial prefrontal cortex, pre-empts any other reasoning processes. This ensures that the individual can quickly and accurately use "cheater detection" to reason through the problem. While going through this process of reasoning about cheater detectors, participants should feel an increase in heart rate and skin conductance because of the potential for punishment described in the story.

According to RT, however, the only thing that will happen during the test is that the Theory of Mind areas of the brain (such as the left amygdala) may show greater activation, merely because the task is asking the participant to understand a discourse occurring between the story's protagonist and antagonist.

Because the behavioral response in either case will be the same, a physiological study is needed to be able to determine the deeper responses that may be going on. If the WST is solved by discourse comprehension, then the same physiological processes found for a participant solving a WST should be the same as the physiological processes for a participant reading and understanding a similar story. Both involve a protagonist and antagonist who are interacting back and forth. On the other hand, if the WST is solved using a pre-emptive cheater detection mechanism, the physiological response should be similar to the responses shown by other participants in emotion-based reasoning tasks.

Therefore, the ideal method for trying to answer the question above, would be to use a physiological study and compare Wason Selection tasks to Comprehension stories. Based on the research at the end of Chapter Three, it seems that an appropriate physiological measure to use would be GSR. However, GSR experiments, like many physiological experiments, are done as within subjects designs. The current literature on the WST is almost universally behavioral and between subjects. Hence, before we could prepare for the GSR experiment, we needed to make sure that we could create a valid

within subjects procedure for the WST; a procedure that would yield the same results as the current between-subject studies already in the literature.

A within-subjects procedure requires that each participant be able to participate in every condition at all levels of the independent variables. However, there were not enough Wason Selections tasks in the current literature to be able to run enough subjects through all the conditions without repetition. Thus, new materials had to be created as well.

Using the process described in Chapter Two, we created new WSTs. The new procedure was the same as previous procedures, except that participants were shown a lot more problems since they were shown both conditions.

The new procedure and materials were tested in experiment one to make sure that we would find a thematic effect for the new materials, even when participants were exposed to both conditions of the experiment. However, experiment one on its own, cannot determine if there were any effects of training or transfer with the new procedure. This necessitated Experiment two. Experiment two used the same materials from experiment one, but presented the different conditions (abstract vs. thematic) in blocks to determine if there was any effect of viewing one type over another. This allowed us to rule out transfer or training, just like with between-subject studies.

After a quick pilot study to test the length, reading times, and accuracies for the Comprehension Stories developed using the process described in Chapter two, we were ready to finally investigate our original research question: Can the thematic effect be better explained by a pre-emptive notion of Cheater detection (SCT) or by simple Discourse Comprehension (RT). The next section of this chapter goes into greater detail about the three experiments that comprise this study and our specific hypotheses for each.

2 The Study

Based on the physiological evidence and the current stalemate in the field, the next logical areas to investigate are the physiological responses of participants performing the thematic WST. This next step is necessary for two reasons:

1. The thematic effect is robust and replicable, yet there is still a lot of disagreement among the seven theories as to why the thematic version produces substantially different results from the abstract version. Our results will shed some light on the underlying process, as well as determining whether the WST is an appropriate task for the study of reasoning.
2. The current physiological work on the WST task tested the effects of emotional training only for the abstract version, and there have been no skin conductance studies on the thematic version of the task.

Objectives

The study had three objectives.

Objective 1: We intended to replicate previous research findings concerning the lack of transfer on different versions of the WST and the null effect of repeated exposure to the task using new materials and a new procedure.

Objective 2: We intended to show that basic performance feedback, unlike previous feedback methods, improves participant performance on both versions of the task. Using performance feedback, we hoped to train participants to 100% accuracy on both versions of the WST. However, even though participants may be performing at 100% on the versions of the task, we anticipated that they would be unable to verbalize their strategy.

Objective 3: We intended to investigate any differences in physiological responses for participants performing the thematic WST compared to reading a thematic story.

Plan and Hypotheses

To accomplish the three objectives above, the study consisted of two stages: Behavioral and Physiological. For each stage, the hypotheses are outlined along with the details of what would constitute supporting and null findings.

Behavioral Stage

Hypotheses:

1. The new materials and procedures will elicit a substantial thematic effect, as predicted by previous research.
2. There will be no transfer between abstract and thematic problems.
3. Strict behavioral feedback will allow participants to be successfully trained to perform both abstract and thematic versions of the task.

Positive results:

Case 1: Participants have significantly higher performance for the thematic version of the WST versus the abstract version.

Implication: This result would lend support for our first hypothesis, that the new materials and procedure are fundamentally similar to previous studies.

Case 2: Participant performance on the thematic task when they have solved this problem first will be higher or equal to their performance on the thematic task when it follows an abstract task.

Implications: This result provides support for the second hypothesis and would replicate previous studies.

Case 3: Participants will be able to form a stable correct strategy for solving both the thematic and abstract version of the task. This will be measured by how many problems, in a row, the participant is able to solve.

Implications: This finding would provide support for hypothesis three and would show evidence of a new effective form of training. While predicting by behaviorist research in learning, it has not been tested in the realm of the WST.

Null Results:

Case 1: Participants show no difference in performance between the abstract and thematic version of the WST, or there is improved performance for the abstract when compared to the thematic stories.

Implication: This is the null hypothesis for our first prediction and it could be due to one of two things. First, if there were no performance difference between any pair of stories, including stories that have been modified from Cosmides (1989), then this would imply that the results would be due to the procedure alone. This would raise interesting questions about how the repetition of the task led to the elimination of the thematic effect. This result would be contrary to previous studies.

Second, if there were a thematic effect for stories modified from Cosmides (1989), but not for the new stories, then this would imply that, despite being similar in form, the new stories are substantially different from previous studies.

Case 2: We find a positive (or negative) correlation between type of problem seen first (abstract or thematic) and performance on later problems of the opposite type, then this would imply that transfer has occurred between the tasks using the new procedure. For example, if seeing an abstract problem first, improved performance on later thematic tasks (when compared to performance on the thematic task when the first problem viewed is a thematic task), then this would imply transfer.

Implications: This finding would necessitate further research into how and why we found transfer, even though other studies have not.

Case 3: Participants will be unable to form a stable, correct strategy for solving the thematic and/or the abstract version of the task. This will be measured by the participant's inability to consistently get problems correct (i.e. showing evidence of having to relearn the solution multiple times throughout the experiment).

Implications: If only one type of story shows evidence for lack of training, this would raise interesting questions about the differences between abstract and

thematic stories, and why one is easier to learn when compared to the other. If neither version shows evidence of training, then this would support past research in the WST, but would provide disconfirming evidence for a number of established behavioral learning theories.

Physiological Stage

Hypothesis:

The thematic WST will produce greater galvanic skin responses when compared to galvanic skin responses on thematic stories.

Positive results:

Case : Greater galvanic skin response while reading the stimulus stories for the WST and for solving WST problems when compared to reading thematic stories and answering the associated comprehension questions.

Implications: This would lend support for our hypothesis and would imply that participant's are using knowledge of future consequences (such as being fired from the job described in the task) to help them reason. This case is predicted by Bechara's work and would support Social Contract theory.

Null Results:

Case 1: No differences are found for the thematic WST when compared to thematic stories in participants' physiological responses.

Implication: Performance on the thematic WST is not determined by anticipation of punishment or emotional strategies. Instead, performance is based on strategies used in discourse comprehension. This would lend support for the Relevance theory.

The next chapter describes each of the experiments in significantly greater detail, before discussing the results and implications of each in turn.

Chapter Five: Experiments

Experiment 1: Materials and Procedure Testing

Method

Participants

Fifty nine undergraduate students participated in exchange for extra credit in their Psychology course. Participants were recruited through classroom announcements, sign-up sheets, and fliers.

Materials

All materials used in the Behavioral stage are listed in Appendix E (p.98). The tasks used were very similar to the two examples presented previously (p. 3). The WST is comprised of four components: the story, instructions, the rule to follow, and the card choices. Each of the tasks in this study had all four elements, but only two were considered as experimental conditions. The story was either abstract or thematic. Thematic was further divided into familiar versus unfamiliar. The rule was either in its normal order (If P then Q) or switched order (If Q then P). The instructions for all the abstract tasks were identical, and the instructions for the thematic tasks varied only in the parts specific to the context of the story (e.g. "Indicate only those card(s) you definitely need to turn over to see if the police cheated any of the suspects"). The choices for each tasks were not specifically controlled and were made to be as uniform as possible (e.g. Which student to check: Bill, Amy, Paul, Adam).

Abstract versions of the stories were modeled after Wason's (1967) original task. Thematic stories were social contract stories that involved someone being cheated. About a third of the social contract stories were modified versions of the stories used in Cosmides (1989). Modifications included shortening the stories, so that abstract and social contract stories were closer in length. Neither version of the task included the words "must" nor "may" in the rule. Both versions of the task included instructions to look for violators of the rule. This was done to ensure that the rules and instructions between the conditions were as similar as possible.

There were two practice tasks (one abstract and one familiar social contract) and 16 test tasks. Of the 16 test tasks, eight were abstract, four were familiar social contract, and four were unfamiliar social contract stories. The 16 tasks were randomly selected from a larger set of 32. Each story had four problems, two of which presented the rule in its normal order ("If P then Q"); the other two problems presented the rule in switched order ("If Q then P").

Reading times, problem solving times, and accuracy measures were collected to ensure that these materials elicited effects similar to those that have been found in previous studies.

Finally, there was a questionnaire where participants were asked to provide their demographic information and were asked what strategies they had used for the tasks.

Procedure

All tasks were given to each participant in a within-subjects design. To ensure that participants understood the format of the experiment, they were first shown the two practice tasks in randomized order. After completing the practice tasks, participants were asked if they had any final questions before beginning the set of sixteen test tasks. These tasks were broken up into eight sets of two. In each set, participants were shown an abstract and social contract task in randomized order. This ensured that participants would never see more than two in a row for any type of problem.

For each task, the presentation of the experiment went as follows: (1) Participants were shown the story, by itself, on a computer screen; (2) When they finished reading the story, they were required to click "Continue" to move to the next screen; (3) The next screen displayed one of the four problems related to the story. The rule, the instructions, and the card choices were presented, in that order, on the screen. Regardless of whether the rule was normal or switched, it was just labeled "Rule". The card choices were also randomly ordered. Over the course of the experiment, participants were asked to use the mouse to select or deselect their card choices. When participants finished selecting their choices for any given problem, they were required to click on "Continue" to move to the

next problem. After completing four problems, clicking "Continue" moved participants to the next story.

After they completed the sixteen tasks, participants were asked to answer a questionnaire about their demographics and strategies. In addition to the standard questions concerning education and age, participants were also asked how many math or logic classes they had taken.

Results

There were two main hypotheses for experiment one. The first hypothesis was that there would be a significant difference in accuracy between the three types of WSTs (abstract, unfamiliar SCTs, familiar SCTs). Second, we hypothesized that there would be no difference between the tasks used in previous experiments and the new tasks for this experiment. Overall, the results strongly support both hypotheses.

For the first hypothesis, we first compared the abstract versus thematic conditions with a paired t-test which revealed that participants responded significantly faster to the abstract problem (M=10.35 seconds, SD=4.10) when compared to thematic problems regardless of familiarity (M=16.57, SD=7.23), $t(58)$=-6.37, p<.001. A second paired t-test indicated that participants were significantly less accurate at answering abstract problems (M=.08, SD=.18) than thematic ones (M=.33, SD=.29), $t(58)$=-7.94, p<.001. Table 4 holds the Descriptive statistics for Experiment 1 and Table 5 lists the paired t-tests.

Dependent Variable	Condition	Mean	Std. Deviation
Story Reaction Time	Abstract	16.587	7.244
	Thematic Familiar	25.680	9.401
	Thematic Unfamiliar	38.024	14.959
Problem Response Time	Abstract	10.353	4.104
	Thematic Familiar	17.234	9.140
	Thematic Unfamiliar	15.897	6.918
Accuracy	Abstract	7.97%	18.36%
	Thematic Familiar	29.18%	28.60%
	Thematic Unfamiliar	36.11%	32.41%

Table 4: Experiment 1: Descriptive Statistics for Abstract vs. Thematic

Dependent Variable	Condition	Mean	Std. Deviation	t	df	Sig
Accuracy	Abstract	7.97%	18.36%			
	Thematic	32.64%	29.25%			
	Mean Differences	-24.67%	29.73%	-6.374	58	0.000
Story Response time	Abstract	16.59	7.24			
	Thematic	31.85	11.31			
	Mean Differences	-15.27	7.62	-15.378	58	0.000
Problem Response Time	Abstract	10.35	4.10			
	Thematic	16.57	7.24			
	Mean Differences	-6.21	6.01	-7.941	58	0.000

Table 5: Experiment 1: Paired T-Tests for Abstract vs. Thematic

Next, we compared the familiar to the unfamiliar thematic. Paired sample t-tests were used to test for differences with each dependent variable. The paired-sample t-test comparing means between the reading time for the familiar social contract condition and the unfamiliar condition provided significant results, $t(58)=-8.946$, $p<.001$. The unfamiliar condition read time took significantly longer ($M=38.02$ seconds, $SD=14.49$ seconds) than the familiar condition ($M=25.68$ seconds, $SD=9.40$ seconds). These results are not necessarily counterintuitive, as the unfamiliar condition contained vocabulary and word usage unfamiliar to the readers. Notably, there was a significant positive correlation between the two conditions, $r=.710$, $p<.001$.

The second paired-sample t-test compared the means between the response time on the familiar and unfamiliar social contract conditions and did not show a significant difference. between the two, $t(58)=1.408$, $p=.165$.

The third paired-sample t-test was done to compare the difference in means between accuracy of the familiar and unfamiliar social contract situations. A significant difference was found, $t(58)=-3.008$, $p<.01$. Participants were significantly more accurate

on the unfamiliar social contract tasks (*M*=.361, *SD*=.324) than on the familiar social contract tasks (*M*=.291, *SD*=.286).

Descriptive statistics for the Familiar vs. Unfamiliar comparison are listed in Table 6 and paired t-test values are in Table 7.

Dependent Variable	Type	Mean	Std. Deviation	N
Story Response Time	Familiar	25.68	3.77	8
	Unfamiliar	37.64	9.55	8
	Total	31.66	9.35	16
Problem Response Time	Familiar	17.45	3.11	8
	Unfamiliar	15.74	3.31	8
	Total	16.60	3.23	16
Accuracy	Familiar	30.83%	10.60%	8
	Unfamiliar	34.66%	6.18%	8
	Total	32.74%	8.61%	16

Table 6: Descriptives for Familiar vs. Unfamiliar

Dependent Variable	Condition	Mean	N	Std. Dev	95% Confidence Interval of the Difference		T	df	Sig.
					Upper	Lower			
Accuracy	Familiar	29.18%	59	28.60%					
	Unfamiliar	36.11%	59	32.41%					
	Mean Difference	-6.93%		17.71%	-11.55%	-2.32%	-3.008	58	0.004
Story Response Time	Familiar	25.68	59	9.40					
	Unfamiliar	38.02	59	14.96					
	Mean Difference	-12.34		10.60	-15.11	-9.58	-8.946	58	0.000
Problem Response Time	Familiar	17.23	59	9.14					
	Unfamiliar	15.90	59	6.92					
	Mean Difference	1.34		7.29	-0.56	3.24	1.408	58	0.165

Table 7: Paired t-Tests for Familiar vs. Unfamiliar

Overall, the results of the paired t-test analyses indicate that individuals took longer reading the unfamiliar tasks, completed the tasks at approximately the same time, and were more accurate on the unfamiliar task.

For the second hypothesis a test of within-subjects contrasts found significant differences between the original versus new story condition for story response time. Newer stories took less time to read than old ones $F(58)=13.005$, $p<.001$. No differences in accuracy or problem response time was found. See table 8 for descriptive statistics and table 9 for the significance values.

Dependent Variable	Condition	Mean	Standard Deviation
Story Response Time	Original	36.914	14.840
	New	30.476	12.214
Problem Response Time	Original	15.422	6.633
	New	17.439	8.246
Accuracy	Original	34.92%	31.72%
	New	30.77%	29.24%

Table 8: Descriptive Statistics. Old vs. new stories.

Condition	Dependent Variable	F	Sig.
Original vs. New Stories	Story Response Times	13.005	0.001
	Problem Response Times	2.516	0.118
	Accuracy	2.142	0.149

Table 9: F and Significance Values, Old vs. New stories.

Discussion

The majority of the results are consistent with previous WST experiments. Thematic effects have been extensively documented throughout the WST literature. In this study, however, participants performed better on unfamiliar SC tasks. While this does not pose a problem for Cosmides's SCT, because both familiar and unfamiliar contained social contract and cheater detection situations, it could be interpreted as evidence against RT. This result is contrary to previous studies and could be due to the novelty of the unfamiliar situations. Some of the more imaginative stories could have led to increased cognitive engagement on the part of the participants.

The difference in story reading times and problem response times are due to differing lengths between the different story conditions. Specifically, unfamiliar thematic tasks were much longer than the abstract WSTs. This is a materials effect and cannot help us compare RT and SCT.

Finally, for the thematic condition, accuracy was on the lower end of the range found in previous studies (25%-80%; L. Cosmides, 1989; Klaczynski et al., 1989). This is most likely due to participant fatigue. The experiment was quite long and, by the end, participants had seen 32 stories and had answered four problems for each. Figures 3 and

4 show the number of people at the different performance levels for both abstract and thematic tasks. For both conditions, there were a significant number of people who got absolutely none right. This could be due to lack of participant motivation to begin with. Future studies using this procedure should decrease the number of stories presented and remove the normal versus switched rule condition to decrease the number of problems presented per story.

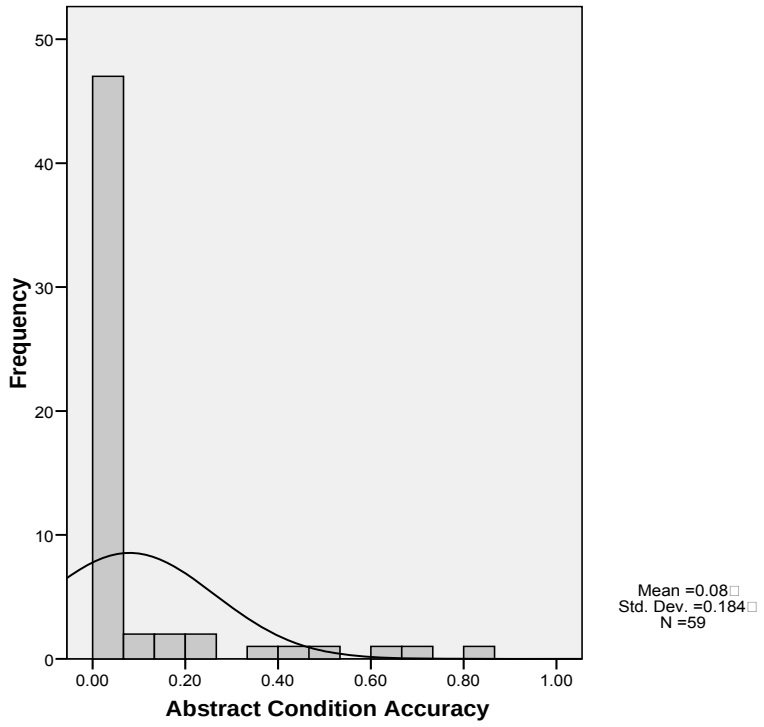

Figure 3: Frequency of accuracy results: Abstract Condition

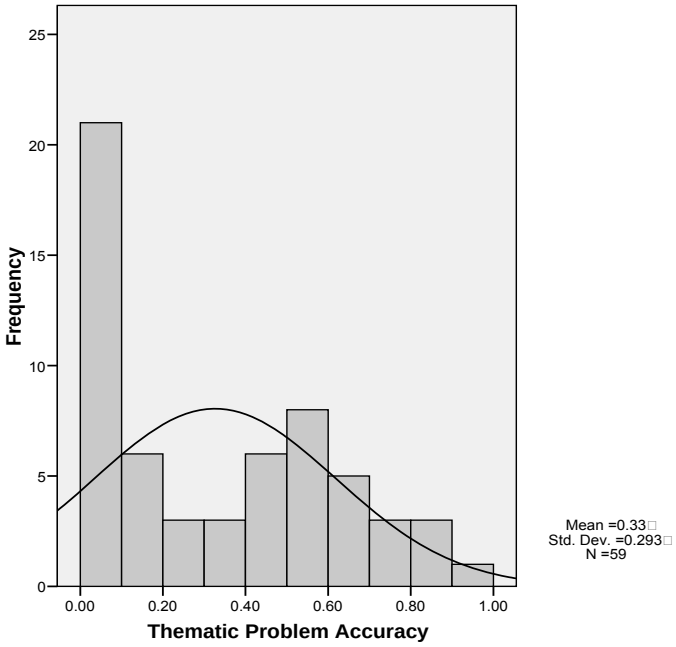

Figure 4: Frequency of accuracy results: Thematic condition

These results support the main goal of experiment one and show that the new, within-subjects procedure was appropriate to the study of the WST and that the new tasks were matched to previously tested materials. Unfortunately, there is no way to determine if there was any transfer between the tasks, because of the random ordering of the stories. To investigate this, experiment two was developed.

Experiment 2: Behavioral training

Method

Participants

Fourteen undergraduate students participated in exchange for extra credit in their Psychology course. Participants were recruited through classroom announcements, sign-up sheets, and fliers.

Materials

Since there was no significant difference in accuracy between the new stories and stories from previous experiments, experiment two used the same stories from experiment one.

Procedure

The procedure for training participants was the same as for Experiment 1, with four exceptions. First, progression through the experiment was not participant controlled. Participants were given a set amount of time to perform each task. The amount of time that participants were given was based on the average reading times for each condition from experiment one.

Second, participants were shown blocks of abstract and thematic tasks (counterbalanced) rather than having the two conditions interwoven. This was done so that we could compare the different learning rates between the abstract and thematic versions of the task and so that we could investigate transfer.

Third, during the trial tasks, participants were given feedback concerning their performance. If they got the problem correct, they were shown a screen that said "Correct" and moved onto the next problem. If they were incorrect, participants were shown a screen that said "Incorrect". The problem was presented again, with the correct choices highlighted. After five seconds of viewing this screen, they were retested on the problem that they had done incorrectly. Participants were not able to proceed to the next problem or story until the incorrect problem had been answered correctly.

Finally, the questionnaire at the end asked participants to explain their strategy for abstract and thematic tasks.

Results

There were two main hypotheses for Experiment 2: (1) That there would be no transfer between abstract and thematic versions of the task and (2) Behavioral feedback would allow participants to be trained on both versions of the task. Table 10 shows the initial descriptive results.

Condition	Type	Dependent Variable	N	Mean	Std. Deviation
Abstract	Total	Time to First Select	14	6199.15	2194.78
		Time to Finish	14	10251.31	1338.66
		Tries per Problem	14	1.39	0.24
Thematic	Total	Time to First Select	14	13164.96	21405.37
		Time to Finish	14	13340.17	14506.67
		Tries per Problem	14	1.42	0.13
	Familiar	Time to First Select	14	8017.08	3080.41
		Time to Finish	14	9034.74	1203.52
		Tries per Problem	14	1.43	0.18
	Unfamiliar	Time to First Select	14	18312.83	41863.33
		Tries per Problem	14	1.40	0.14

Table 10: Descriptive Statistics. Experiment 2

For the first hypothesis we used the between-subjects variable of block order to determine if negative or positive transfer was going on. The between-subjects analysis was not significant, but there were significant effects found for the within subjects condition (abstract vs. thematic), $F(13)=3.95$, $p<0.043$,and for the interaction between block and condition, $F(13)=5.28$, $p<.0019$ (See Table 11). The interaction effect is shown in Figure 5.

Effect		F	Sig.	Observed Power
Between Subjects	**First Shown**	1.33	0.319	0.25
Within Subjects	**Condition**	3.95	0.043	0.66
	Condition * First Shown	5.28	0.019	0.79

Table 11: Tests of Between-Subjects Effects

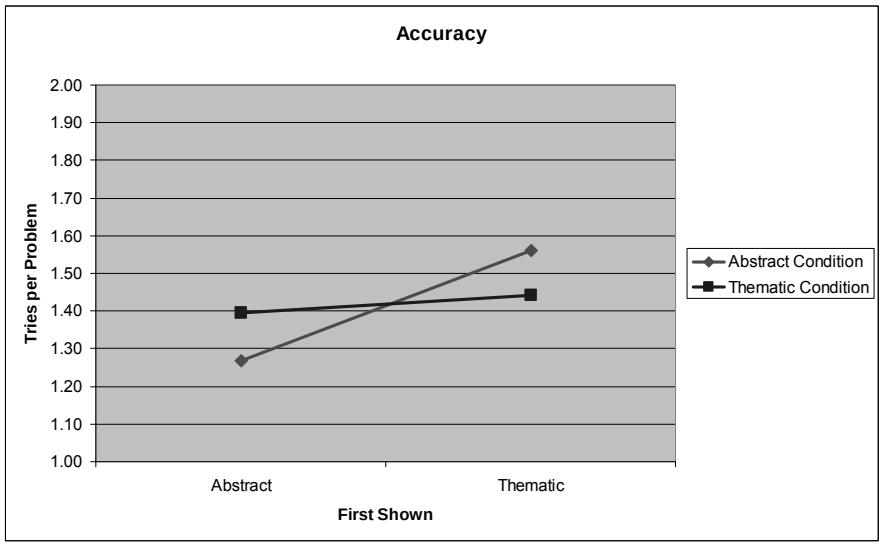

Figure 5: Interaction effect for Condition x Block

For the second hypothesis, a repeated measures of variance analysis was conducted to determine if there was a significant difference in performance based on the. Significant results of presentation order were found for each of the three dependent variables: (1) Time to first selection of a card, (2) Time until completion, and (3) Number of tries per problem. A Wilk's $\Lambda = .167$, $F(2,12)= 7.265$, $p<.001$ indicates that there was enough of a significant variance across all three measures of performance to warrant further individual analysis. Descriptive statistics for these results are provided in Table 12.

Set	Dependent Variable	First Shown	Mean	Std. Deviation	N
First set of five	Tries Per Problem	Abstract	1.59	0.26	8
		Thematic	1.78	0.27	6
		Total	1.67	0.27	14
	Time to First Select	Abstract	8161.54	3037.94	8
		Thematic	8582.58	1807.73	6
		Total	8341.98	2504.62	14
	Time to Finish	Abstract	8917.48	1252.04	8
		Thematic	7696.23	1297.13	6
		Total	8394.09	1372.80	14
Last set of five	Tries Per Problem	Abstract	1.18	0.16	8
		Thematic	1.23	0.17	6
		Total	1.20	0.16	14
	Time to First Select	Abstract	4555.33	2008.01	8
		Thematic	5996.86	2124.38	6
		Total	5173.13	2110.67	14
	Time to Finish	Abstract	10531.09	1570.39	8
		Thematic	9710.34	1514.61	6
		Total	10179.34	1545.29	14

Table 12: Descriptive statistics for performance over time.

A significant portion of current research is directed at determining whether learning occurs (e.g. Houde, 2000, 2001; Price & Driscoll, 1997). Therefore, paired t-tests were conducted with the "first five problems" and "last five problems" measurements. The first paired t-test compared measurements of time until first select and found a significant difference between the first five problems and the last five, as the last five problems were answered in a significantly shorter time than the first, $t(14)=6.165$, $p<.001$.

The second paired t-test compared how long it took participants to finish a problem. This showed another significant result in that the time between first selection

and final selection (of the first try on an answer) got *longer* as the participants gained experience, $t(14)=-4.093$, $p=.001$.

Finally, a paired t-test comparing the number of tries per problem, indicated fewer attempts over the course of the experiment, $t(14)=6.165$, $p<.001$. All of these results indicate that performance improved. All three t-Tests are summarized in Table 13.

Dependent Variable	Set	Mean	Std. Dev.	Std. Error Mean	t	Df	Sig
Tries per Problem	First set of Five	1.67	0.27	0.07			
	Last set of Five	1.20	0.16	0.04			
	Mean Difference	0.47	0.28	0.08	6.165	13	0.000
Time to First Select	First set of Five	8341.98	2504.62	669.39			
	Last set of Five	5173.13	2110.67	564.10			
	Mean Difference	3168.85	1928.50	515.41	6.148	13	0.000
Time to Finish	First set of Five	8394.09	1372.80	366.90			
	Last set of Five	10179.34	1545.29	412.99			
	Mean Difference	-1785.26	1631.82	436.12	-4.093	13	0.001

Table 13: Experiment 2: Paired t-Tests

Discussion

The results support both of the hypotheses for experiment two. The first hypothesis for experiment two was that there would be no transfer effects between the abstract and thematic blocks. As expected from previous studies (e.g. Osman & Laming, 2001; Evans et al, 1996) the results supported this hypothesis. Because participants only received behavioral feedback, and the answer pattern was different between the two blocks[9]

[9] The correct answer for the switched rule version of the abstract stories was ~P and Q, whereas the thematic stories had the pattern P and ~Q for both the normal and switched rule versions of the task

positive transfer was unlikely. Further, negative transfer, sometimes observed for thematic tasks following abstract ones (Griggs & Cox, 1982), was *not* found.

The second hypothesis was that participant performance would improve with behavioral feedback. Previous studies on training have focused on fixing the participant's Mental Model by helping them understand the task's general form and its underlying logic (e.g. Cheng et al., 1986 and Klaczynski et al., 1989). The only study that was able demonstrate successful training of participants was Houde et al (2001). They incorporated an emotional element into their feedback on the logic of the task (e.g. 'Don't fall into this logical trap!'). This yielded improved performance and increased activation in an area of the brain thought to be linked to emotional reasoning, the right ventromedial prefrontal cortex.

On the other side of the spectrum is this study, which provided no verbal feedback and, instead, forced the participants to form their own heuristic for solving the problem. A commonly cited concern of Houde et al (2001) is that it unknown whether or not the increased performance and activation were due to an internalization of the logic-emotion strategy or frustration at trying to formulate a new strategy. This study confirms that this is certainly a valid concern because participant performances improved without the explicit training for a new strategy, but with plenty of frustration as the participants were forced to find one on their own.

There was a large standard deviation for accuracy over the course of the experiment. Looking at figure 6, it becomes apparent that there was a subset of participants who disengaged from the task and pushed buttons without thought. Changing the form of the feedback given (to either not show the correct answer or to have extended lengths of time sat waiting) might encourage greater motivation.

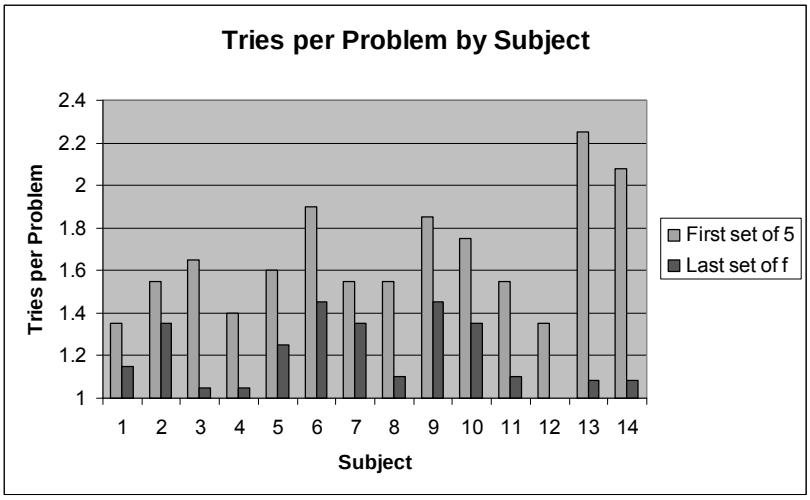

Figure 6: First set of 5 and Final set of 5, tries per problem per Participant

Experiment 3: Physiological Study

Currently, most studies concerning the WST are behavioral. Unfortunately, behavioral studies have not resolved the conflict between Cosmides's SCT and Sperber, Cara, & Girotto's RT. Each side argues that the preponderance of the evidence for the opposing side is flawed, either due to procedural problems or material confounds.

Both theories have very specific, and differing, claims concerning the reasoning mechanism behind participant performance on the WST and the associated physiological and neurological responses. This study approaches the problem from a physiological standpoint in the hopes of providing converging evidence for one of these theories. At the very least, it may expand research on the WST into areas that might prove more fruitful.

Method

Participants

Participants were recruited through fliers posted at the University of MN and online ads placed on http://craigslist.com. Out of the 33 participants, 28 had usable data (five had their data erased due to computer crashes).

Materials

This was a 2 x 2 design with the first condition being task type, either a WST or a Discourse story. The second condition was familiar versus unfamiliar subject matters. Most of the WSTs were taken from experiments one and two and the rest were created from previous experiments. Of the four WST components, only the story and rule were varied across condition, and the instructions and card choices were kept as uniform as possible. The Discourse stories were created from the WSTs, but followed a narrative. Each of the Discourse stories consisted of four elements (parallel to the four elements for the WST): story, instructions, questions, and choices. Discourse stories were matched on subject matter, length, and accuracy to the WST stories (based on a pilot study). Explicit instructions to detect cheaters were present in the WSTs but not in the Discourse Story task type. Each WST story was followed by four problems using normal versus switched rules. Discourse Story stories were followed by four multiple choice questions concerning the content of the story. Card choices for the WST were kept as uniform as possible (like in the previous studies) as were the question choices for the Discourse Story tasks. Unlike typical multiple choice questions, more than one answer could be correct.

The experiment itself was programmed in ePrime and had triggers for the beginning of each story, each problem, each card selection, and each card de-selection. These triggers marked times for the skin conductance data in Neuroscan 4.2.

Procedure

The presentation and initial setup of the experiment (e.g. practice sessions, how the stimulus was presented, etc) were the same as in the prior experiment. The setup for gathering physiological data was a bit more complicated, however.

Participants were seated at a computer terminal while the experimenter explained the process of the study and positioned five surface electrodes. Two of the electrodes were secured to the participant's nondominant hand to collect skin conductance responses (palmar skin conductance). Another two electrodes were placed in the crook of each arm to collect heart rate information. Finally, a fifth electrode was placed on the side of the

neck as a ground. Heart rate information was primarily gathered to help determine which participant responses should be rejected.

Participants were asked to try to limit their movements (especially movements of the hand with the SCR electrodes). Participants used a button box to respond to the stimuli and were explicitly shown how to select and deselect choices using the button box. Each participant knew that all the tasks could have 0, 1, 2, 3, or 4 correct answers.

After a practice session with one thematic WST (Griggs & Cox's Drinking Age problem) and a matched Discourse Story (described two police officers who were working undercover at a bar to catch underage drinkers), participant questions were answered before they moved on to the actual experiment. They were shown eight WSTs, and eight Discourse stories in random order.

Participants were monitored from outside the room using a video/camera speaker system. Participant progress on the task was also viewable from an external computer console.

After 16 stories, eight WST and eight Comprehension stories, the experiment ended and the participant filled out a questionnaire to gather demographic information. They were then debriefed on the content of the study and paid $20.

After the study Neuroscan and Matlab were used to create a response window of -100 to 4000 ms for each trigger. The baseline and the maximum amplitude were scored, by hand, for each of the triggers for each of the participants. SPSS was then used to analyze these values.

Results

Accuracy and Response Times

Based on a pilot study, it was hypothesized that there would be no significant difference in accuracy across the types of tasks and their familiarity. A repeated measures analysis of variance was conducted to determine if there were significant differences between the accuracy and response time on both the Wason Card Selection Task and the Discourse Story Tasks with both the familiar and unfamiliar story types. In all, this made for a 2x2x2 design, which required significant post hoc analysis. Based upon the

repeated measures ANOVA, significant differences were found between the measurement methods (accuracy and response time) and the specific tasks and subtypes, $F(6,192)=48.64$, $p<.001$. Descriptive statistics are available in Table 14 below.

Measure	Condition	Type	Mean	Std. Deviation	N
Accuracy	SCT	Familiar	41.29%	24.50%	33
		Unfamiliar	60.98%	12.98%	33
	Discourse Stories	Familiar	38.07%	28.10%	33
		Unfamiliar	70.08%	11.77%	33
Response Time	SCT	Familiar	111.19	20.11	33
		Unfamiliar	479.87	50.42	33
	Discourse Stories	Familiar	437.63	92.99	33
		Unfamiliar	481.79	91.33	33

Table 14: Descriptive Statistics for Behavioral measures

Paired t-tests were conducted to further analyze these findings, first within the individual problem type (SCT versus Discourse stories) with regards to familiar and unfamiliarity, and then between problem types. When comparing within the SCT group, differences in accuracy and response time were present. Participants were significantly more accurate when answering the unfamiliar subset ($M=.60$, $SD=.13$) versus the familiar subset ($M=.41$, $SD=.25$), $t(32)=-4.237$, $p<.001$. Participants also took longer with the unfamiliar subset ($M=479.87$, $SD=50.42$) when compared to the familiar subset ($M=111.19$, $SD=20.11$), $t(32)=-36.70$, $p<.001$. T-Test results are in Table 15.

Measure	SCT	Mean	Std. Deviation	95% Confidence Interval		t	df	Sig.
				Upper	Lower			
Problem Response Time	Familiar	111.19	20.11					
	Unfamiliar	479.87	50.42					
	Mean Difference	**-368.68**	**57.71**	**-389.14**	**-348.21**	**-36.699**	**32**	**0.000**
Accuracy	Familiar	41.29%	24.50%					
	Unfamiliar	60.98%	12.98%					
	Mean Difference	**-19.70%**	**26.71%**	**-29.17%**	**-10.23%**	**-4.237**	**32**	**0.000**

Table 15: Descriptive Statistics for Behavioral measures. SCT condition

A similar exploration of the Discourse Story tasks revealed similar results for the accuracy measurement and similar, albeit muted, results for the response time measurement. A paired t-test for accuracy when comparing the Discourse Story unfamiliar accuracy (M=.70, SD=.12) and familiar subgroup accuracy (M=.38, SD=.28) revealed significant results, $t(32)$=-5.88, p<.001. A paired t-test for response time for the unfamiliar (M=481.76, SD=91.33) and familiar subgroups (M=437.66, SD=92.33) for the Discourse Story problems showed similarly that participants took more time with the unfamiliar subgroups, but these results were not significant, $t(32)$=2.01, p=.053. T-test results are in Table 16.

Measure	Discourse Stories	Mean	Std. Deviation	95% Confidence Interval		t	df	Sig.
				Upper	Lower			
Problem Response Time	Familiar	437.63	92.99					
	Unfamiliar	481.79	91.33					
	Mean Difference	**-44.16**	**126.18**	**-88.90**	**0.58**	**-2.010**	**32**	**0.053**
Accuracy	Familiar	38.07%	28.10%					
	Unfamiliar	70.08%	11.77%					
	Mean Difference	**-32.01%**	**31.24%**	**-43.08%**	**-20.93%**	**-5.886**	**32**	**0.000**

Table 16: Descriptive Statistics for Behavioral measures. Discourse Stories

Comparing between the Wason Selection Task and Discourse Story type indicated that participants answered the WST familiar task faster than both the Discourse Story familiar, $t(32)=-20.18$, $p<.001$ and the unfamiliar, $t(32)=-23.49$, $p<.001$ problem subgroups. The WST unfamiliar task yielded mixed results as individuals solved WST unfamiliar tasks significantly more slowly than the Discourse Story familiar tasks, $t(32)=2.42$, $p<.025$. Comparing the WST unfamiliar task response times to the unfamiliar Discourse Story subgroup yielded no significant results.

Another comparison between groups using accuracy as a measurement yielded results of mixed significance. Comparisons between the WST and Discourse Story familiar subtasks were nonconclusive, but comparing WST unfamiliar problem accuracy with Discourse Story familiar accuracy yielded significant results, $t(32)=4.60$, $p<.001$ with the WST problem being solved more accurately. The WST familiar subproblem when compared to Comprehension unfamiliar subproblem yielded the opposite effect, $t(32)=--6.07$, $p<.001$. Finally, when both WST and Discourse Story were compared for the unfamiliar problems, respondents were significantly more accurate in the Discourse Story condition, $t(32)=-3.08$, $p<.01$.

Finally, a general comparison between groups indicated that participants spent more time on the Discourse Story questions, ($M=495.71$, $SD=67.19$) than the WST

questions (*M*=295.53, *SD*=25.32), *t*(32)=-14.82, *p*<.001. Overall, there was *no* significant difference in accuracy for the WST (*M*=.51, *SD*=.14) and Discourse Story (*M*=.54, *SD*=.15) general problem types, *t*(32)=-1.33, *p*=.19. This data is summarized in Table 17.

Dependent Variable	Condition	Mean	N	Std. Dev	t	Df	Sig
Response Time	SCT	295.53	33	25.32			
	Discourse Stories	459.71	33	67.19			
	Mean Difference	**-164.18**		**63.66**	**-14.82**	**32.00**	**0.000**
Accuracy	SCT	51.14%	33	14.36%			
	Discourse Stories	54.07%	33	14.83%			
	Mean Difference	**-2.94%**		**12.72%**	**-1.33**	**32.00**	**0.194**

Table 17: Paired T-Tests

Galvanic Skin Response

The main hypothesis for experiment three focused on participants' predicted physiological changes. Specifically, it was hypothesized that WSTs would cause a greater physiological response than Discourse Story tasks. A repeated measures analysis of variance was conducted to determine if there was a difference in the amount of physiological change for the four different sets of problems: (1) familiar WSTs, (2) unfamiliar WSTs, (3) familiar Discourse stories and (4) unfamiliar Discourse stories. The results indicate significant variance across the different conditions, *F*(3,25)=13.79, *p*<.001. Table 18 includes all the means and standard deviations for these categories.

Measure	Condition	Type	Mean	Std. Deviation	N
Amplitude Change	SCT	Familiar	1634.33	265.71	28
		Unfamiliar	1653.22	173.72	28
	Discourse Stories	Familiar	1639.20	228.83	28
		Unfamiliar	1548.15	186.29	28
Time of Max Amplitude	SCT	Familiar	71.17	51.85	28
		Unfamiliar	71.13	48.72	28
	Discourse Stories	Familiar	65.61	45.42	28
		Unfamiliar	80.99	57.63	28

Table 18: Descriptive Statistics. Time is 'Time relative to Trigger'

Comparing within the basic design, WST familiar and unfamiliar subcategories did not indicate significant results in physiological change, $t(27)=-.697$, $p>.05$. The Discourse Story problems, on the other hand, did demonstrate significant results between the two subproblem categories when compared with a paired t-test, $t(27)=3.125$, $p<.01$. These results indicate that there was more of a physiological response for the familiar subgroup when compared to the unfamiliar one for Discourse stories. See tables 19 and 20 for the full results of these two paired comparisons.

Measure	Discourse Stories	Mean	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Amplitude Difference	Familiar	1636.76	46.14		1542.09	1731.44
	Unfamiliar	1600.68	33.08		1532.80	1668.57
	Mean difference	**36.08**	**25.17**	**0.163**	**-15.56**	**87.72**
Trigger Time	Familiar	68.39	9.02		49.88	86.91
	Unfamiliar	76.06	10.00		55.54	96.58
	Mean difference	**-7.67**	**3.44**	**0.035**	**-14.73**	**-0.60**

Table 19: Paired Comparisons. Discourse Stories

Measure	SCT	Mean	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Amplitude Difference	Familiar	1,643.77	40.20		1,561.29	1,726.26
	Unfamiliar	1,593.67	36.64		1,518.49	1,668.86
	Mean difference	**50.01**	**10.19**	**0.000**	**29.19**	**71.01**
Trigger Time	Familiar	71.15	9.37		51.94	90.37
	Unfamiliar	73.30	9.45		53.91	92.70
	Mean difference	**-2.15**	**1.75**	**0.229**	**-5.73**	**1.43**

Table 20: Paired comparisons. SCT

When comparing between the groups, there were not significant differences in physiological changes between the WST and Comprehension familiar categories, and the WST unfamiliar and Discourse Story familiar categories. There were significant differences when comparing WST familiar and Discourse Story unfamiliar groups, $t(27)=3.08$, $p<.01$ and when comparing the WST unfamiliar and Discourse Story Unfamiliar groups, $t(27)=6.57$, $p<.001$. In *both* cases, the WST condition generated more physiological response than the Discourse Story condition.

A broader comparison between the two general problem categories revealed that WST problems generated significantly higher physiological responses than Comprehension problems, $t(27)=-4.92$, $p<.001$.

Dependent Variable	Condition	Mean	N	Std. Deviation	Std. Error Mean	t	Df	Sig (2-Tailed)
Amplitude Change	Discourse Stories	1593.67	28	193.89	36.64			
	SCT	1643.77	28	212.72	40.20			
	Mean Difference	**-50.10**		**53.92**	**10.19**	**-4.92**	**27**	**0.000**
Trigger Time	Discourse Stories	73.30	28	50.01	9.45			
	SCT	71.15	28	49.56	9.37			
	Mean Difference	**2.15**		**9.23**	**1.75**	**1.23**	**27**	**0.229**

Table 21: Paired comparisons. SCT vs. Discourse Stories

Discussion

For the behavioral analysis of stage three, it was hypothesized that there would be no differences in accuracy for either type of task, regardless of familiarity. The results partially support this. Accuracy was not significant when comparing WST and Discourse stories. However, significant differences were found for the familiarity condition. Participant performance was higher on unfamiliar tasks than on familiar ones.

Problem response time was also analyzed and it was found that participants spent longer on comprehension stories and spent longer on unfamiliar tasks. The greater response time for the unfamiliarity condition could help explain the improved performance for this condition (due to increased diligence). A difference in response time for the WSTs and discourse stories did not lead to a significant difference in accuracy.

For the physiological analysis, it was hypothesized there would be a significant difference in physiological activation between the WST and discourse stories. In line with SCT, it was anticipated that WSTs would have greater physiological activation due

to the triggering of a cheater detection mechanism, which would in turn trigger a participant's anticipation of punishment (i.e. anticipation of being cheated).

Relevance Theory, on the other hand, would predict no difference in activation between the WSTs and the Comprehension stories. This is because RT argues that WSTs and narratives are two instantiations of the same general discourse comprehension model, rather than an evolved, specific mechanism for one and not the other.

The results supported our hypothesis and showed significantly higher physiological activation for the WSTs compared to the Comprehension stories. This provides converging evidence for Cosmides's SCT.

Chapter Six: Findings and Conclusion

The WST is probably the single most researched test of logic. One of its trademark features is the thematic effect, where participants perform significantly better on thematic versions when compared to abstract versions of the task (see Table 4). The problem is that researchers disagree as to why. Social Contract Theory, proposed by Cosmides (1989), argues that this effect is found because thematic stories trigger an emotionally based, "cheater-detection" mechanism. Whereas Relevance Theory, proposed by Sperber, Cara, & Girotto (1995), argues that the more parsimonious explanation for the thematic effect is that it cues people into strategies that they have developed for discourse comprehension, just like any other social story or situation. This controversy has caused stagnation in the field and has led many researchers to question the validity of studying the WST at all.

Unfortunately, all studies doing a direct comparison among the two theories were purely behavioral. This study sought to examine the task and the predictions of the two different theories using a physiological study to complement the many behavioral studies that already exist in the field.

The physiological measure chosen for this study was skin conductance response. This was based on a solid field of research studying emotional reasoning, and, in particular, anticipation of punishment. These concepts are key differences between SCT and RT: See Chapter Three.

Due to the more complicated nature of physiological experiments, and the increased time and expense, the typical between-subjects procedure was not as feasible as a within-subjects one. Before a physiological, within-subjects experiment was carried out, however, it was necessary to create, and test, a within-subjects procedure for the WST, along with the extra materials required for it (see Chapter Four). Both the materials and the procedure needed to be tested to ensure that (1) they elicited the same thematic effects that had been found with the typical between-subjects behavioral studies and (2) they did not lead to an unanticipated transfer effect. Because within-subjects

studies expose the participants to a much larger count of tasks across both conditions (giving them time to form strategies), it was necessary to show that there was an absence of transfer, even in training conditions. Experiment one tested the procedure and the new set of materials. Experiment two ensured that the new procedure did not elicit any evidence of transfer or training.

1 Summary of Behavioral Stages

The purpose of experiments one and two were to (1) establish that the thematic effect existed for the new procedure and materials and (2) to make sure that a within-subjects procedure did not lead to transfer between conditions, even when the participants were trained. These two goals drove the overall hypotheses for stages 1 and 2 and were based on the large body of existing research on the WST (e.g. Griggs & Cox, 1982 for the thematic effect and Cheng, 1986 for lack of transfer effects).

The results of experiments one and two provided significant support for our hypotheses. In the first study participant performance on abstract tasks were close to chance (much like other WST studies) with significantly higher performance on thematic tasks. Unexpectedly, participants performed better on unfamiliar tasks, and this result was found throughout the study as whole. Problem solving time and reading time were also found to be significant in experiment one. The length of the stories between conditions varied, so both experiments two and three made sure to match stories from different conditions on length.

In the second study, similar performance results were found with no evidence of transfer between the two conditions. In some participants, this lack of transfer was found despite successful training.

2 Summary of Physiological Stage

Once confidence in the new within-subjects procedure and with the new materials was established, a direct comparison of SCT and RT could be done with physiological data. The main hypothesis for this stage was synthesized from two disparate, but related fields, namely, the behavioral research on the WST and the physiological research on emotional

versus logical reasoning. It was hypothesized that despite similarity in accuracy between the conditions, there would be a difference in physiological activation (see Chapter Three).

The behavioral results for experiment three showed no significant difference in accuracy between the WST and Discourse Story conditions, replicating a pilot study that was done to help match the materials on accuracy and length. The physiological results showed significantly more activation for the WST condition as predicted by SCT. This difference in activation is more indicative of two different reasoning processes underlying performance for WST versus discourse comprehension. Whereas, RT hypothesizes that it is the same process, with two different instantiations.

3 Limitations of the current study

There were two potential limitations of the current study. For both experiments one and two, the results for the thematic WSTs were on the lower end than what was found previously. While this was most likely due to participant fatigue, it could still call into question the reliability of the materials. It is likely that a similar depression of results would have been evident for the abstract WSTs if they were not already below chance (see Figures three and four). A way to unconfound this result would be to test the materials with fewer trials per subject. Since normal versus switched rule conditions were not significantly different, the number of problems per story can be reduced from four to one. This would likely improve performance on both conditions, but more so for the thematic.

Secondly, there was a potential limitation to experiment three. While all the materials in experiment three were matched for time, topic and accuracy, information on the tone of the narratives was not gathered. The very nature of thematic WSTs used to test SCT is confrontational. Every story promised severe punishment and negative consequences (e.g. being fired, being banished, having the universe explode, etc.) if the participant failed in their task to catch cheaters. The Comprehension stories, on the other

hand, tended to be more light hearted. For example, the Drinking-Age WST threatens participants with being fired if they fail, whereas the Discourse Story version told of two police officers having fun at their job.

It could potentially be argued that the reason WSTs showed greater physiological activation is due to the participant's empathy for the protagonist of the stories, rather than being indicative of their underlying reasoning processes. This confound could be tested for, and controlled for, in future studies by matching the WST stories and the Discourse stories on emotional valence, as well as on length, topic, and accuracy. This could be done through a simple pilot study that asked participants to rate the level of their anxiety after reading the story, using a simple Likert scale. However, the emotional difference between the stories was slight and only existed for a handful of them. Thus, we hypothesize that the difference on anxiety levels would not be significant enough to account for the large difference in physiological activation between the two conditions.

4 Future Studies

All three experiments found results that certainly warrant further exploration. In experiment one, the accuracy rates for all conditions were lower than previous studies. A study that attempted to reduce participant fatigue by reducing the number of trials is likely to get higher accuracy results that are more in line with the current research.

Second, the finding that participants were successfully trained on the WST using strict behavioral feedback in experiment two, just begs for further explanation. Replicating this study with think-aloud procedures could provide invaluable feedback as to how participants form heuristics when forced to do so. A study of this form, would also be able to more clearly distinguish between participants who were engaged versus 'sandbagging' on the task.

Finally, besides the confound-reducing suggestions for follow-up studies mentioned in the previous section an obvious follow up to this study would be to attempt to replicate these differences in physiological activation by using a different physiological measure

i.e. neurological activation differences. Based on studies like Houde (2000, 2001) and Bechara (1999), we hypothesize that when SCT tasks trigger the "cheater detection" module there will be greater activation in the ventromedial prefrontal cortex when compared to thematic stories. The very nature of the SCT tasks lead to anticipation of punishment, which could activate somatic heuristics for reasoning emotionally. If this result is found, it would provide significant support for Social Contract theory and would provide a clearer link between the thematic WST and previous research from Houde (2000, 2001) and Bechara's work on the VMPFC (ventromedial prefrontal cortex).

On the other hand, if RT is correct, activation on both tasks would be the same and there would likely be greater activation in areas that have been linked with control of selective attention such as the dorsal occipital cortex (Woldorff et al., 2002). This would indicate that performance on the thematic WST is just due to refocusing the participant's attention to the correct response, lending support for Relevance theory.

A more thorough study proposal, as well as a comparison of what different patterns of activation results could mean for each of the theories is further described in Appendix D.

5 Implications

The implications for future WST and broader research concerning emotional reasoning is three-fold. First, experiment one has supplied a new procedure and accompanying materials that could be used for future research in both the WST and related logical tasks. Both of these have been tested extensively, refined, and verified.

Experiment two found that unlike previous feedback methods for the WST, strict behavioral feedback did lead to participants being trained on the different versions of the task *without* transfer between the two. This raises more questions and opens the doors for future cognitive studies that are complemented with behavioral techniques.

Finally, such significant results in the physiological arena will certainly encourage more research and interest in both the WST and other logical tasks that have heretofore been restricted to the behavioral realm.

Overall, the results from these three experiments were stronger than we could have hoped for. Many of the hypotheses were supported with firm, significant results. Like Griggs& Cox (1982), we found substantial thematic effects, Like Cheng & Holyoak (1985), we found no evidence of transfer. Like Bechara (2002) and Houde (2000), we found physiological results indicating that emotional reasoning plays a significant role, beyond mere discourse comprehension (despite Bechara's research being done in a different field).

Sperber, Cara, & Girotto (1995) argue that the Wason Selection task is more a test of discourse comprehension than it is of reasoning, and, as such, should be abandoned in reasoning research. However, our positive physiological results indicate that something more specialized is going on. Hopefully, the positive results and converging evidence that the physiological data describe, will jar the current research out of its stalemate and lead to another forty years of fruitful exploration and further understanding of human reasoning.

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Appendix A: Summary Tables

Card Chosen	Logical Inference
P	Modus Ponens -Given a true antecedent, concludes that the consequent is true.
Not P	Denial of the Antecedent (FALLACY) -Given a false antecedent, concludes that the consequent is false.
Q	Affirming the Consequent (FALLACY) -Given a true consequent, concludes that the antecedent is true.
Not Q	Modus Tollens -Given a false consequent, concludes that the antecedent is false.

Table 22: Given the rule "If P, then Q"

Thematic effect (p. 6)	Materials which are familiar increase logical performance over materials which are not.	(Cox & Griggs, 1982; J. S. Evans et al., 1993; Griggs & Cox, 1982; Wason & Johnson-Laird, 1972)
Matching Bias (p. 7)	The tendency for participants to select cards that make the antecedent and the consequent true, regardless of the presence of negatives in the rule or on the cards. 1. Occurs more often on Abstract materials. 2. Occurs equally often for verifying versus falsifying instructions. 3. Occurs more often when the negatives are implicit rather than explicit. 4. Logical form affects matching bias.	(J. S. Evans, 1972; J. S. Evans et al., 1995; J. S. Evans, Clibbens et al., 1996; J. S. Evans, Ellis et al., 1996; J. S. Evans et al., 1999; J. S. Evans et al., 1993; Oaksford & Stenning, 1992; Roberts, 2002)
Training and Transfer (p. 9)	1. Logical training does not improve performance. 2. Education does not improve performance. 3. Positive transfer is very rare. Some evidence has been found that it can be possible, but only through extensive or emotional feedback.	(Cheng et al., 1986; Jackson & Griggs, 1988, Cox & Griggs, 1982; Evans et al., 1995; Evans, Clibbens et al., 1996; Houde et al, 2000; Houde et al, 2001; Johnson-Laird et al., 1972; Klaczynski et al., 1989; Osman & Laming, 2001; Price & Driscoll, 1997; Wason & Shapiro, 1971)
Wording Effects (p. 12)	1. Use of "must" facilitates performance. 2. Violation instructions facilitate performance. 3. Explicit negatives facilitate performance 4. Facilitation is always greater when these are combined	(Fiddick et al., 2000; Fiedler & Hertel, 1994; Griggs & Cox, 1982; Jackson & Griggs, 1990; Kroger, Cheng, & Holyoak, 1993; Margolis, 1987; Platt & Griggs, 1993; Staller et al., 2000)

Table 23: Summary of established findings

Theories	**Basic Arguments**	**Hypothesized area of Activation**
Social Contract Theory (p. 20)	1. Abstract version: People are not logical. 2. Thematic version: Cheater detection module being used.	Thematic WST will activate areas linked with emotional reasoning tasks (VMPFC). Thematic stories will activate theory of mind areas to the same degree that thematic WSTs will.
Relevance Theory (p. 28)	1. All performance on the WST is influenced by processes involved in discourse comprehension. 2. Thematic WSTs are just better matched to stories that we are practiced in comprehending.	There will be no difference in activation or galvanic skin response for the thematic WST and the thematic stories.

Table 24: Summary of Theories relevant to the Proposed Study

Appendix B: Matching Bias

As matching bias has been studied, four results specifically concerning the WST have been established. First, matching bias occurs primarily on abstract versions of the task (J. S. Evans et al., 1995). Evans et al. (1995) used a rotating negatives paradigm to compare abstract and thematic materials with three different rule forms: (1) "If P, then Q", (2) "P only if Q", (3) "Q if P". After asking participants to judge and generate their own conclusions to the rules (in addition to solving the WST), he found that only abstract problems showed a significant effect of matching bias. His two other findings were (1) that Affirming the Consequent errors occur significantly more often than Denying the Antecedent errors, and (2) he found evidence for a negative conclusion bias for both types of stories. Negative conclusion bias is the tendency for participants to make Denying the Antecedent, Affirming the Consequent, and Modus Tollens inferences more often when the form of the conclusion is negative.

The second result concerning the WST is that instructions to verify or falsify the rule do not limit matching bias (J. S. Evans, Ellis et al., 1996). The only difference between these two instructions is whether participants are asked to pick cards that "verify the rule" or whether they are asked to pick cards that "falsify the rule". Through four experiments (using shape and color conditionals) they tested the effects of (1) Form, "If P, then Q" versus "P only if Q"; (2) negations; (3) Truth of the rule: absolutely true, fuzzily true, fuzzily false, and absolutely false; and (4) Instruction type, verify versus falsify the rule. They found significant effects for matching bias in both instruction conditions.

Third, matching bias has been found to be most prevalent when implicit versus explicit negatives are used (J. S. Evans, Clibbens et al., 1996). Over the course of three experiments they tested the effects of form ((1) "If P, then Q", (2) "P only if Q", (3) "Q if P") and explicit versus implicit negation. They found that even though explicit negative and implicit negative groups performed the same logically (very low accuracy for each group), the implicit group showed significant effects of matching bias, regardless of

form. From this, they conclude that matching bias cannot be the sole cause for all of the logical errors participants make.

Finally, it has been found that significant changes to the logical form of the rule affect matching bias. There are two studies that illustrate this point. The first is Evans et al. (1999). Through three experiments, they tested (1) rotating negatives, (2) instruction type, and (3) logical form. Unlike his previous experiments, the logical forms in this experiment were not logically equivalent conditionals. The first form was the standard "If P then Q", the second was "All P are Q", the third was a disjunction ("P or Q"), and the last was a negated conjunction ("not both a P and a Q") (J. S. Evans et al., 1999). They found that instruction type interacted with logical form to increase or decrease matching. Falsification instructions led to more matching for all forms except the negated conjunction (which had much higher rates of matching with verification instructions). Once again, there was no difference in logical performance between any of the groups.

The second study illustrating logical form effects on matching bias is Roberts (2002). Using rotating negatives, this study compared conditionals with disjunctives. He found that conjunctions were significantly affected by matching bias, but that disjunctives seemed to elicit a reverse matching bias. He concludes that the matching bias phenomenon is entirely due to the participants misunderstanding the task.

The above studies are just a few that have found matching bias effects in the WST. Overall, across different stories, rules, and experiments, matching bias has been found to be a very robust effect…and all without affecting logical performance.

Appendix C: Findings concerning Wording Changes on the WST

Kroger, Cheng, & Holyoak (1993) mostly tested violation instructions, but they also tested explicit versus implicit negatives on abstract permission rules and abstract arbitrary rules. Like Griggs & Cox (1982) they found no facilitative effects of wording on the abstract arbitrary rules. However, they did find that violation instructions or explicit negatives alone were not enough to facilitate performance for the permission rule problem over the arbitrary problem. Substantial performance increases for permission rules were only found when explicit negatives were combined with violation instructions. However, they did not test the situation where there are no violation instructions and no explicit negatives. So, it could be the case that there was a small effect of facilitation for each of these things.

Jackson & Griggs (1990) ran a very similar experiment, but, in addition to testing abstract permission rules and abstract arbitrary rules, they also tested abstract obligation rules. Like other studies, they found that the abstract arbitrary version of the task showed no facilitation for any of the wording changes, but they did find facilitation for permission and obligation rules. They found that when negatives are explicit: (1) performance improved with violation instructions, as opposed to "true or false" instructions (avg.: 31.5% versus 19.75%) and (2) there was better performance for abstract permission rules, followed by abstract obligation rules (abstract arbitrary rules had the lowest performance). However, without explicit negatives, there were no differences between any of the groups and the average correct was a mere 6.5% over all three types of problems. In addition, when checking information was removed (look for violators), performance was very poor regardless of whether there were implicit or explicit negatives. They conclude that explicit negatives and violation information only facilitate performance when there are other features available that can also facilitate performance.

Unlike the above studies, Platt & Griggs (1993) studied the effects of using the word "must" in the rule (described previously p. 23). They found that the introduction of the word "must" significantly improved performance and, like Jackson & Griggs (1990),

they found that explicit negatives also improved performance, but only when there were other types of facilitating information in the problem. They found these facilitative effects even when cost-benefit information and cheater perspective information were removed.

Appendix D: Theories on the Wason Selection Task

D.1 Domain General Theories: Evidence For and Against

Mental Logic Theory

There are two main arguments for Mental Logic theory (MLT). The first stems from a number of experiments by Rips (Rips, 1989, 1990, 1993). Based on think-aloud protocols from previous experiments, he constructed a program (in PROLOG) that was based on a set of ten logical rules and mimicked participant responses. Through two different experiments, he showed that participants took longer to solve more complex problems and often made more errors on them, as compared to simpler problems. Complexity was determined based on the number of inferences that the program needed to generate to find a solution. Rips also found that, when participants were asked to write down the inferences they were making, their responses closely modeled the inferences made by the program. Now, while the task used was not the WST (it was a Knights and Knaves problem), Rips argues that the WST has similar inferencing requirements. He concludes that the MLT, based on his program, explains the current results, whereas Heuristic-Analytic theory, Pragmatic Reasoning Schemas, and the Mental Models theory cannot.

The second argument is from Ahn & Graham (1999). They argue that the reason that participants do not appear to reason logically on the abstract version of the WST is because "of ambiguities in [the problems'] necessity-sufficiency status" p. 241. By clarifying the rule's necessity and sufficiency status, participants perform logically. For example, "If P then Q" can be interpreted in three different ways: (1) "If, and only if P then Q" (P is both necessary and sufficient for Q), (2) "If P, then maybe Q" (P is necessary, but not sufficient for Q), and (3) "If P then Q and if not P maybe Q" (P is sufficient, but not necessary for Q) (Ahn & Graham, 1999). Through two experiments, they compared the effects of modifying (1) the necessity-sufficiency status, (2) the perspective, and (3) the lexicalization of the cards, on four different stories (three thematic and one abstract). Where possible, they used stories from Gigerenzer & Hug

(1992), described later (p. 23). They found that neither perspective nor lexicalization had any effect on performance when necessity and sufficiency information was modified. Most importantly, they found that by clarifying the necessity and sufficiency relations in the rule (through context), participants responded normatively (logically). They argue that thematic versions of the task facilitate performance merely because these relations are made clearer through context and that participants can and do reason from a set of logical rules.

There are three arguments against MLT. The first is from Evans et al. (1995) described previously (p. 96). They argue that the MLT cannot account for the pattern of results that have been found behaviorally. For example, MLT predicts that the logical fallacies of Affirming the Consequent and Denying the Antecedent should occur at the same frequency. However, Affirming the Consequent occurs much more frequently than Denying the Antecedent. Very rarely do participants choose "not P," but choosing "Q" is one of the most common answers. In addition, Evans et al. (1995) found evidence for a negative conclusion bias, which should not occur if people are using logical rules to reason from.

The second argument against MLT is that logical rules are not innate, as the theory proposes, but are instead generalized from existing pragmatic reasoning schemas (Chao & Cheng, 2000). Chao & Cheng tested two groups of children, four and seven year olds, on two tasks, a negative permission rule versus a negative arbitrary rule (negative rules were used to ensure that logical answers were not the same as answers due to matching bias). Using a modified WST, they asked children about each of the four inferences that could be made from the rule. For both age groups, children made significantly more Modus Ponens and Modus Tollens inferences on the permission rule than on the abstract rule. From these results, they argue that Modus Ponens develops before Modus Tollens and that the pragmatic rules, for both, develop before they are generalized. According to MLT, Modus Ponens, at the very least, should be an explicit, innate rule. Chao & Cheng conclude that "pragmatic reasoning rules emerge earlier than explicit formal rules" (p. 52), meaning that some of the basic tenets of MLT are violated.

The final argument against MLT is not an argument against the theory as whole; instead it argues against its attempt to explain the WST. Osman & Laming (2001), described in more detail previously (p. 11), argue that "Wason's task, as it has conventionally been implemented, involves no reasoning (except to the extent that "reasoning can be subsumed in "understanding")" (p. 143). Based on the participants' patterns of card selection and on the errors that they make, the most likely explanation for their behavior is that they are merely choosing cards that are most obvious in the rule and are not engaging in any reasoning at all.

Mental Models theory

Using the WST, there are three different arguments for the Mental Models theory (MMT). The first is that perspective effects on the WST argue for a Mental Models interpretation. Perspective effects are generally described as the differing patterns of card selections based on what perspective the context of the story encourages the reasoner to take. There are two different studies that make the argument that perspective effects support MMT. First, Manketelow & Over (1991) argue that reasoners cannot be using schemas to solve the WST, because reasoners take into account different expected utilities based on their perspective. Through three experiments, Manketelow & Over tested the effects of altering perspectives and rotating negatives. The different perspective versions of the problem differed only in context and in the conditional. Manketelow & Over found robust perspective effects and conclude that participants must be using a mental model of the problem, because they are evaluating the expected utilities of the problem from different perspectives.

Staller et al, (2000) makes a related argument, but uses a different method. To elicit different perspectives, they used two contexts that emphasized either "P and not Q" or "not P and Q" using a *non-deontic* conditional. Previously, all other theories argued that perspective effects were available only with deontic conditionals, because of the nature of either social contracts or permission rules. Staller et al. (2000) used descriptive rules which, generally, have no real 'perspective'. However, by modifying the context, they were able to elicit the same pattern of results using descriptive rules. They conclude

that domain specific theories cannot account for the finding of perspective effects in non-deontic domains. The MMT, on the other hand, not only can explains it, it predicts it.

The second argument for Mental Models theory is that the presentation of the task can affect the formation of the mental model and, therefore, participant performance. Legrenzi et al. (1993) showed participants a conditional with a secondary premise. However, some participants saw the conditional first, whereas others saw the secondary premise first. When the secondary premise was presented first, Modus Tollens inferences were made significantly more often. They argue that when the conditional is presented first, the secondary premise has to be incorporated into the existing mental model. This puts a strain on working memory. However, when the secondary premise is presented first, then the conditional is just compared to the existing mental model and evaluated. A ready prediction that comes from this is that, if the cards are presented before the rule in the WST, then "not Q" selections should increase.

The final argument for MMT is that the behavioral evidence has confirmed one of their predictions. Evans et al. (1995) and Evans, Clibbens et al. (1996), both described previously (p. 95), found that Affirming the Consequent errors occur much more frequently than Denying the Antecedent errors. However, even though they present confirming evidence for the MMT, they later go on to argue that modifications to the theory are needed.

The main argument against the MMT is that, even though some of the behavioral evidence supports it, the majority of the evidence does not. Evans et al. (1995), described in more detail previously (p. 95), found results contradictory to some key predictions of MMT. First, they found no evidence of affirmative premise bias (against MMT's first prediction). Second, they found very strong evidence for a negative conclusion bias in both abstract and thematic materials. Evans argues that MMT proponents cannot account for this finding unless they add post-hoc corollaries to their model or get rid of their explanation of matching bias (but then they would not be able to explain matching bias). Evans, Ellis, et al. (1996), described previously (p. 95), found that participants chose "not P" and "Q" more often on "P only if Q" rules. This implies that they are reading "P only

if Q" rules as "If Q then P" rules. According to MMT, the syntactical form does not change the underlying logic, so this should not occur. In addition, they found that participants were more likely to choose "not P" and "not Q" on "If P then Q" rules than on "P only if Q", contrary to MMT's prediction that the "only" will focus reasoners' attention on the negative components of the rule. Finally, Evans et al. (1999), described previously (p. 96), found similar results to Evans, Ellis, et al. (1996), that there was no difference in logical performance with "P only if Q" rules. In fact, they found that performance was slightly worse on "P only if Q" rules than on "If P then Q" rules.

Heuristic-Analytic model

The first of the three arguments for the Heuristic-Analytic model (HA) is that, by changing the instructions, different parts of the problem appear more relevant. Griggs & Jackson (1990) compared three different types of instructions: (1) "circle those card or cards that violate the rule", (2) "circle two cards to turn over to see if the rule has been violated", and (3) "Your task is to figure out which two cards violate the rule and circle them" (p. 200) on an abstract problem and an abstract permission rule problem. According to HA, the second instructional manipulation should cause selections of "P & Q" to increase, whereas the third set of instructions should cause "not P and not Q" to increase. They found dramatic results.

The second set of instructions doubled the amount of "P & Q" chosen when compared to the first set, and the third set of instructions caused over a six-fold increase in "not P and not Q" selections when compared to the first set. The instruction change also increased logical performance. They conclude that manipulations that try to increase logical understanding in WST fail, whereas manipulations that try to change the focus of attention succeed. Different linguistic features make different choices seem more relevant and that determines performance. Overall, this supports HA's notion that the WST does not involve reasoning.

Like with most of the other theories, there are behavioral results that support some of HA's predictions. Evans, Clibbens et al. (1996), described previously (p. 95), found supportive evidence for HA's If-heuristic. Namely, that selections of "P" massively

outnumbered selections of "not P". They conclude that card selection does not seem to be based on reasoning, but instead on the apparent relevance of the cards.

The final argument for HA is that reasoning is unlikely to be a factor in WST, because the card selection appears to be automatic. Roberts & Newton (2001) had participants do the WST either as a rapid response time task or as a free time task. They tested both abstract and thematic stories. They found that (1) participants spent longer inspecting cards they chose (which lends credibility to HA's argument that any time spent investigating the choices is not due to reasoning about them, but to rationalizing why they chose them), (2) the rapid response time task led to more matching, and (3) there was no difference in performance between the two tasks. They conclude that there is certainly evidence for the argument that participants do not reason on the WST. However, they do introduce a caveat that there may have been analytical thinking in the free time task.

There are two main arguments against HA. The first is that, if HA argues that heuristics are used to identify which choices are relevant in the WST, then they can not explain why highly irrelevant selections are still chosen (Kirby, 1994). Kirby (1994) gave participants the drinking-age problem from Griggs & Cox (1982) except they added two more choices to the task. Usually, the choices are "Drinking beer" (P), "drinking Sprite" (not P), "21" (Q), and "17" (not Q). Kirby added two more "not Q" choices, i.e. "12" and "4". According to HA theory the two extra "not Q" cards are highly irrelevant because children of those ages are very unlikely to be mistaken as being old enough to drink beer. If the WST never makes it out of the heuristic stage, then those two card should never be chosen. However, those cards, even though there were chosen less often, were still chosen at rates of 70% and 65% for "12" and "4" respectively. HA can not account for this finding without abandoning its argument that the WST never reaches the analytical stage.

The final argument against HA, is that there are behavioral findings that are contrary to their predictions. Feeney & Handley (2000) tested participants on abstract and thematic tasks with implicit or explicit negatives. In addition, they gave participants two

conditionals rather than one. The first was the standard conditional that is used in the WST. The second rule had the same consequent, but a different antecedent. The antecedent was either a single item or a disjunction. They found no effect of problem or negation type, but they did find that two rules decreased "P" and "Q" choices and increased "not Q" choices, while the disjunctive rule increased "not P" choices. Both of these findings are directly contrary to HA. HA predicted that explicit negatives would increase all card selections and that a second rule would increase "Q" selections. Feeney & Handley argue that these results support deductive models of reasoning.

D.2 Domain Specific Theories: Evidence For and Against Each

Pragmatic Reasoning Schemas Theory

There are five main arguments in support of Pragmatic Reasoning Schemas (PRS). First, Cheng & Holyoak (1985) argue that PRS is the only explanation for why, on otherwise identical tasks, facilitation is observed for those tasks that involve permissions. Over the course of three experiments, they compared permission rule problems, with and without a rationale, to abstract problems. The rules of each story were presented in two forms: "If P then Q" and "P only if Q". The participants were asked to do the following two tasks (in counterbalanced order): to solve the problem and to rephrase the rule in the problem to the other form. So, if participants were given a rule in "If P then Q" form, they were asked to rewrite it in "P only if Q" form. They found that (1) problems with a rationale added to it elicited a higher performance than problems with no rationale, and (2) abstract permissions elicited better performance than abstract non-permissions. They conclude that the only explanation for the differences in performance is that the permission rule evoked a permission schema (since the problems were otherwise identical).

In a related study, Cheng & Holyoak (1989) found that pragmatic reasoning schemas facilitated performance, even in the absence of any cost-benefit information. They compared precaution problems with abstract problems and found significant facilitation. They argue that despite the lack of a social contract, facilitation occurred.

They conclude that only PRS can account for these findings. As a side note, Cosmides later added a theory to explain precautions as a "sister" theory to Social Contract theory.

The third argument for PRS is that children show evidence for using pragmatic reasoning schemas in reasoning. Girotto et al. (1989) attempted to replicate Cheng & Holyoak (1985) with children that were 10-14 years old. However, they also added a condition of whether or not the stories were plausible. They found very similar results to Cheng & Holyoak (1985) and they found that performance was increased when the problem was more probable. They conclude that the children showed evidence of using pragmatic reasoning schemas, because of the significant increase in performance for plausible permission rules. Cummins (1996) attempted to replicate Girotto et al. (1989) with 3-4 year olds with deontic versus indicative rules in thematic problems. They found similar results and conclude that their findings illustrate that children start learning to reason through pragmatic reasoning schemas. Finally, Chao & Cheng (2000), described in more detail previously (p. 100), tested children's judgements of inferences from a conditional and found that these schemas are developed at very young ages and that more general rules are developed from these schemas.

The fourth argument for PRS is that permissions facilitated performance even without explicit negatives. (Kroger et al., 1993), described in more detail previously (p. 97), concluded that "No theory based on content-free inference procedures, whether formulated in terms of inference rules or mental models, provides a mechanism by which an abstract deontic context can influence reasoning" (p. 633).

Finally, the only type of training that has been found to facilitate performance on the WST has been training with obligation and permission schemas. Cheng et al. (1986), described previously (p. 9), found that training participants on schemas provided more facilitation for future problems than a full-semester course in logic.

There are two main arguments against PRS. The first is that there is no facilitation on PRS problems without an implicit cost-benefit structure. This argument is made by Cosmides (1989) and Gigerenzer & Hug (1992). Both of these studies focused on Social Contract theory, so they will be described in more detail there (p. 20). Cosmides (1989)

found that the facilatory effects of thematic WST disappeared without a social contract and a cost-benefit structure. In addition, she tested WST with switched rules. Instead of presenting the rule as "If P, then Q" she presented them as "If Q, then P". For the switched problems with a cost-benefit structure, participants chose "Q" and "not P". This card choice is very rare on standard versions of the WST, but it maps directly onto the notions of "benefit taken" and "cost not paid." She argues that PRS cannot account for this finding. Further, Gigerenzer & Hug (1992) found that, by switching the perspective of the story, the pattern of responses also switched. They argue that, according to PRS, switching the perspective should facilitate logical reasoning, instead of eliciting a different illogical response.

The second argument against PRS is that the facilitation effect claimed by PRS is actually due to a materials effect. Jackson & Griggs (1990), described in more detail previously (p. 97), tested the effect of different types of wordings on both permission rules and abstract problems. They found, contrary to Kroger et al. (1993), that when explicit negatives and violation checking instructions were removed, performance on permission rules was just as poor as performance on abstract ones. From this they conclude that the facilitation effect found for obligation and permission rules cannot be due to participants using a pragmatic reasoning schema. Ahn & Graham (1999), described previously (p. 99), argue along similar lines. They contend that, once the necessity-sufficiency relations on the task are made clear, logical performance will improve, regardless of whether it is a permission rule or an abstract rule. Ahn & Graham conclude that the Mental Logic theory is more parsimonious and more fundamental than any theory concerning domain-specific mechanisms.

Utility Theory

There are two main research findings that support Utility Theory (UT). The first is that set size influences card selections (neither PRS nor SCT can account for this). Kirby (1994) used two different manipulations over the course of four experiments: (1) Set size and (2) reason given. Set size was for the antecedent condition only and could be small, medium, or large. The reasons were designed to increase or decrease the utility of

different card choices and were all given in the context of the drinking age problem. The baseline was a "Check" version where the context encouraged participants to check for violators. The second version was "Don't check". The context in this version of the problem highlighted that the manager of the bar would be very cross if you tried to ID customers who were of age. The third version was a "Don't Miss" version; the context highlighted that the bouncer's job may be lost if he or she did not catch underage drinkers.

Kirby gives three predictions: (1) that selections of "not Q" will increase as the size of P increases, (2) the second version of the reason condition will decrease the number of cards chosen, and (3) the third version of the reason condition will increase the number of cards chosen. He asked participants to perform two tasks: a WST and a probability judgement task, where participants were asked to rate the likelihood of each card choice. The results provided support for all three of his predictions. He concludes that the effect of the antecedent set size can only be explained through UT and that expected utilities and information gain is currently a confound in tasks involving both pragmatic reasoning schemas and social contracts.

The second argument for UT is that the perceived utility of different choices can be affected by the participants' perceived level of responsibility. Mancini & Gangemi (2002) modified the context of the stories so that they conveyed a sense of high levels of responsibility (i.e. "you are the only one who is in charge of the patient") versus low levels of responsibility (i.e. "you are one of a larger group that cares for the patient"). Significant differences were found between these two conditions. They argue that participants in the low responsibility condition did not have an "active normative goal" in mind while solving the problem. They conclude that reasoning is guided by the content of a task (not by its structure) and by its perceived utilities.

There are two main arguments against UT. Like most of the other theories, the first argument against UT is that it cannot account for the behavioral findings on the WST. In a theoretical paper, Evans & Over (1996) argue that, according to UT, the card "not P" would have a very low amount of information associated with it (since it has no affect on

the truth of "Q"). However, Kirby (1994) failed to explain his finding of very high rates for "not P" cards. In addition, UT predicts that, as the likelihood of the conditional being true goes up, the informational value of "not Q" increases. While Kirby (1994) did find that participants chose "not Q" more often as the set size of the antecedent increases, he cannot explain findings from other studies that show that participants are more likely to choose "not Q" when the conditional is likely to be false (Evans, Clibbens, et al., 1996). Similarly, Hattori (2002) asked participants to solve a WST and to rank the card choices (in the order that they would choose to flip them over) with either a high or a low antecedent set. By increasing the set, participants were more likely to choose "P" (contrary to UT) and the set size had no effect on "not Q" responses. Hattori argues that only a subset of the participants were using probabilistic information and that "the probability information given in a task is not sufficient to change responses in the selection task for all participants" (p. 1266). She concludes that UT cannot be a general model for performance on the WST, because it is too inconsistent.

D.3 Overview

	Arguments for	Citations	Arguments against	Citations
Mental Logic Theory (p. 14)	1. Behavioral evidence indicates that people reason logically 2. When the necessity-sufficiency status of the rules are clarified, people perform normatively	(Ahn & Graham, 1999; Rips, 1989, 1990, 1993)	1. Behavioral findings violate the prediction that AC inferences occur equally as often as DA inferences. 2. Not innate. Logic rules generalized from pragmatic reasoning schemas. 3. The WST does not involve reasoning.	(Chao & Cheng, 2000; J. S. Evans et al., 1995; Osman & Laming, 2001)
Mental Models Theory (p. 15)	1. Perspective effects only explained by MMT. 2. Presentation of the problem, affects the representation of it. 3. Behavioral evidence supports one of their predictions.	(J. S. Evans et al., 1995; J. S. Evans, Clibbens et al., 1996; Legrenzi et al., 1993; Manktelow & Over, 1991; Staller et al., 2000)	1. Behavioral findings violate four of their predictions.	(J. S. Evans et al., 1995; J. S. Evans, Ellis et al., 1996; J. S. Evans et al., 1999)
Heuristic-Analytic Theory (p. 16)	1. Instruction change can make different features of the problem more relevant. 2. Behavioral results support some of their predictions.	(J. S. Evans, Clibbens et al., 1996; Griggs & Jackson, 1990; Roberts & Newton, 2001)	1. Irrelevant cards are still selected. 2. Behavioral findings violate some of their predictions.	(Feeney & Handley, 2000; Kirby, 1994)

	3. Card selection appears to be automatic.			
PRS theory (p. 18)	1. PRS only explanation for facilitation on otherwise identical tasks. 2. PR problems facilitate performance w/o a cost-benefit structure. 3. Children show evidence of PRS in reasoning. 4. PRS facilitates performance even in the absence of explicit negatives. 5. Training on schemas is the only training that has been found to be effective.	(Chao & Cheng, 2000; P. Cheng & Holyoak, 1989; P. W. Cheng & Holyoak, 1985; P. W. Cheng et al., 1986; Cummins, 1996; Girotto, Gilly, Blaye, & Light, 1989; Kroger et al., 1993)	1. No facilitation on PRS without a cost-benefit structure 2. Facilitation effect claimed by PRS is actually due to a materials effect.	(Ahn & Graham, 1999; L. Cosmides, 1989; Gigerenzer & Hug, 1992; Jackson & Griggs, 1990)
Social Contract Theory (p. 20)	1. Cost-benefit structure facilitates performance on the WST, but it does not facilitate logical thinking. 2. Evidence that this is an evolved mechanism. 3. Evidence of a neurological disassociation.	(Beaman, 2002; Brown & Moore, 2000; L. Cosmides, 1989; Fiddick et al., 2000; Gigerenzer & Hug, 1992; Grams, Finch, & Sheu, 1995; Platt & Griggs, 1993; Stone, Cosmides, Tooby, Kroll, & Knight, 2002; Sugiyama, Tooby, & Cosmides, 2002)	1. Facilitation found w/o a cost-benefit structure. 2. Facilitation is just a materials effect. 3. They are not testing reasoning from evolved mechanisms by using the WST.	(Ahn & Graham, 1999; Almor & Sloman, 2000; P. Cheng & Holyoak, 1989; Fiedler & Hertel, 1994; Liberman & Klar, 1996; D. Sperber et al., 1995; Dan Sperber & Girotto, 2002)
Utility Theory (p. 19)	1. Set size influences card selections: can not be accounted for by PRS and SCT. 2. Perceived responsibility affects the perceived utilities of different items.	(Kirby, 1994; Mancini & Gangemi, 2002)	1. Can not account for the behavioral findings. 2. Findings of set size differences are not consistent.	(J. S. Evans, Clibbens et al., 1996; J. S. Evans, Ellis et al., 1996; J. S. Evans & Over, 1996; Handley, Feeney, & Harper, 2002; Hattori, 2002)
Relevance Theory (p. 28)	1. Linguistic features of the task are responsible for facilitation.	(Almor & Sloman, 2000; D. Sperber et al., 1995; Dan Sperber & Girotto, 2002)	1. WST is a task that involves reasoning about more than discourse. Facilitation due to mis-understandings of the task. 2. Deontic and descriptive rules use different processes.	(Ahn & Graham, 1999; Fiddick et al., 2000)

Table 25: Arguments for and against each of the theories

Appendix E: Proposal for future study

The materials and procedures used for experiment three could be easily modified to work with a variety of other physiological measures. For example, the following illustrates what different neurological activation could mean for each of the theories concerning the WST. Below is a sample procedure that could be used as is.

E.1 Different patterns of results

Case 1: Activation: The thematic WST produces greater activation in the ventromedial prefrontal cortex when compared to thematic stories.

Implications: Performance on the thematic task is determined by reasoning strategies that are linked with emotion. This would lend support for Social Contract theory and would provide a clearer link between the thematic WST and previous research from Houde (2000, 2001) and Bechara's work on the VMPFC (ventromedial prefrontal cortex).

Case 2: The thematic WST leads to greater activation in areas that have been linked to deductive reasoning. i.e. Inferior and middle frontal gyrus (BA 6, 8, 9, 46-47) (Acuna, Eliassen, Donoghue, & Sanes, 2002; Christoff et al., 2001; Goel & Dolan, 2001; Goel, Gold, Kapur, & Houle, 1997, 1998; Kroger et al., 2002; Ruff, Knauff, Fangmeier, & Spreer, 2003)

Implication: Performance on the thematic version of the WST is determined by rational reasoning strategies and not by its emotional context. This would lend support for Domain general theories of reasoning such as the Mental Models theory or the Mental Logic theory.

Case 3: The thematic WST leads to greater activation in areas that are associated with memory or with selective attention (i.e. hippocampal structures).

Implication: The thematic WST is not a reasoning task and is solved by remembering past heuristics or past situations (either due to the repetition of the task or to memories of previous experiences). May provide support for Evan's Heuristic-Analytic theory.

Case 4. Activation: The thematic WST leads to greater activation in areas that have been linked with control of selective attention such as the dorsal occipital cortex (Woldorff et al., 2002).

Implication: Performance on the thematic WST is just due to refocusing the subject's attention to the correct response. Could lend support for domain general theories of reasoning or for Relevance theory.

E.2. Procedure

Participants will be imaged via fMRI (4T) with a prefrontal coil using a blocked design. The trials will alternate between thematic WSTs and thematic stories. For the thematic WSTs, participants will have 30 seconds to read the situation, after this point they will be given 15 seconds to read the instructions for the task. At this point, they will be shown a series of four questions. Each question will consist of a rule, either in the normal form or the switched form, underneath each rule will be four card choices. Problems will be presented in one of the following orders: (1) Normal, Switched, Switched, Normal or (2) Switched, Normal, Normal, Switched. Participants will be given 15 seconds to solve each problem, before they are moved to the next. Each WST will take one minute and 45 seconds.

For the thematic stories, participants will be given 30 seconds to read the story. After the story participants will be shown instructions for the comprehension task. They will be given 15 seconds to read the instructions. Finally, participants will be shown a series of four comprehension problems in randomized order. Participants will be given 15 seconds to solve each problem. Each thematic story task will take one minute and 45 seconds.

Each block will consist of a thematic WST and a thematic story in randomized order. In between each task participants will be presented with a blank screen for 5 seconds. Each block will take 220 seconds. The experiment will consist of eight blocks and take a total of 29 minutes and 20 seconds. There will be a total of eight thematic WST with four problems each, for a total of 32 trials. There will be a total of eight thematic stories with four comprehension problems each, for a total of 32 trials. Participants will be asked to respond to each problem using a button box.

After the experiment is over, participants will be asked to fill out a short questionnaire concerning their strategies.

Appendix F: Materials for the Behavioral Stage

F.1 Abstract Stories

Total Number of Words: 147

Story

You are examining a deck of 52 cards. Each card has a letter on one side and a number on the other. While you are looking through the cards, your friend tells you that only certain letters and numbers can be on the same card. For example, if there is a certain type of letter on the front of the card, then that determines what kinds of numbers can be on the back. Your friend tells you one of the rules that the deck is supposed to follow.

Instructions: On the next screen, you will be shown a rule and four cards that have been drawn from this deck. One side of each card has a letter, and the other side of each card has a number. Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If there is a consonant on one side, then there is an even number on the other side.
Switched Rule: If there is an even number on one side, then there is a consonant on the other side.

Card Sets:

	P	~P	Q	~Q
1	B	A	8	3
2	D	E	6	7
3	J	I	4	5
4	T	U	12	1

Total Number of Words: 149

Story

You are examining a deck of 52 cards. Each card has a letter on one side and a number on the other. While you are looking through the cards, your friend tells you that only certain types of letters and numbers can be on the same card. For example, if there is a certain type of letter on the front of the card, then that determines what kinds of numbers can be on the back. Your friend tells you one of the rules that the deck is supposed to follow.

Instructions: On the next screen, you will be shown a rule and four cards that have been drawn from this deck. One side of each card has a letter, and the other side of each card has a number. Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If there is a vowel on one side, then there is an odd number on the other side.

Switched Rule: If there is an odd number on one side, then there is a vowel on the other side.

Card Sets:

	P	~P	Q	~Q
1	A	C	3	10
2	I	F	11	4
3	U	D	9	6
4	O	H	7	12

Total Number of Words: 159

Story

You are examining a deck of 52 cards. Each card has the name of a color on one side and a number on the other. While you are looking through the cards, your friend tells you that only certain colors and numbers can be on the same card. For example, if there is a certain color on the front of the card, then that determines what kinds of numbers can be on the back. Your friend tells you one of the rules that the deck is supposed to follow.

Instructions: The primary colors are red, blue and yellow. On the next screen, you will be shown a rule and four cards that have been drawn from this deck. One side of each card has the name of a color, and the other side of each card has a number. Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If there is a primary color on one side, then there is an odd number on the other side.
Switched Rule: If there is an odd number on one side, then there is a primary color on the other side.

Card Sets:

	P	~P	Q	~Q
1	Yellow	Orange	3	4
2	Red	Purple	7	6
3	Blue	Black	9	4
4	Red	Pink	11	8

Total Number of Words: 149

Story

You are examining a deck of 52 cards. Each card has a letter on one side and a number on the other. While you are looking through the cards, your friend tells you that only certain types of letters and numbers can be on the same card. For example, if there is a certain type of letter on the front of the card, then that determines what kinds of numbers

can be on the back. Your friend tells you one of the rules that the deck is supposed to follow.

Instructions: On the next screen, you will be shown a rule and four cards that have been drawn from this deck. One side of each card has a letter, and the other side of each card has a number. Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If there is a consonant on one side, then there is an odd number on the other side.
Switched Rule: If there is an odd number on one side, then there is a consonant on the other side.

Card Sets:

	P	~P	Q	~Q
1	G	I	3	10
2	T	E	19	4
3	C	O	9	8
4	S	U	13	6

Total Number of Words: 163

Story

You are examining a deck of 52 cards. Each card has a letter on one side and a shape on the other. While you are looking through the cards, your friend tells you that only certain types of letters and shapes can be on the same card. For example, if there is a certain type of letter on the front of the card, then that determines what kinds of shape can be on the back. Your friend tells you one of the rules that the deck is supposed to follow.

Instructions: A polygon is a closed figure bounded by straight lines. On the next screen, you will be shown a rule and four cards that have been drawn from this deck. One side of each card has a letter, and the other side of each card has the name of a shape. Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If there is a vowel on one side, then there is a polygon on the other side.
Switched Rule: If there is a polygon on one side, then there is a vowel on the other side.

Card Sets:

	P	~P	Q	~Q
1	A	W	Square	Heart
2	I	R	Triangle	Circle
3	O	L	Diamond	Oval
4	U	G	Rectangle	Line

Total Number of Words: 160

Story

You are examining a deck of 52 cards. Each card has a letter on one side and a shape on the other. While you are looking through the cards, your friend tells you that only certain types of letters and colors can be on the same card. For example, if there is a certain type of letter on the front of the card, then that determines what type of color can be on the back. Your friend tells you one of the rules that the deck is supposed to follow.

Instructions: The primary colors are red, blue and yellow. On the next screen, you will be shown a rule and four cards that have been drawn from this deck. One side of each card has a letter, and the other side of each card has the name of a color. Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If there is a vowel on one side, then there is a primary color on the other side.
Switched Rule: If there is a primary color on one side, then there is a vowel on the other side.

Card Sets:

	P	~P	Q	~Q
1	O	R	Red	Violet
2	E	N	Yellow	White
3	A	P	Blue	Pink
4	I	K	Yellow	Orange

Total Number of Words: 162

Story

You are examining a deck of 52 cards. Each card has a number on one side and a shape on the other. While you are looking through the cards, your friend tells you that only certain types of numbers and shapes can be on the same card. For example, if there is a certain type of number on the front of the card, then that determines what kinds of shape can be on the back. Your friend tells you one of the rules that the deck is supposed to follow.

Instructions: A polygon is a closed figure bounded by straight lines. On the next screen, you will be shown a rule and four cards that have been drawn from this deck. One side of each card has a number, and the other side of each card has the name of a shape. Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If there is an even number on one side, then there is a polygon on the other side.
Switched Rule: If there is a polygon on one side, then there is a even number on the other side.

Card Sets:

	P	~P	Q	~Q
1	12	3	Rectangle	Oval

2	4	7	Square	Circle
3	6	5	Triangle	Heart
4	10	9	Diamond	Line

Total Number of Words: 171

Story

You are examining a deck of 52 cards. Each card has a color on one side and a shape on the other. While you are looking through the cards, your friend tells you that only certain colors and shapes can be on the same card. For example, if there is a certain type of color on the front of the card, then that determines what kinds of shape can be on the back. Your friend tells you one of the rules that the deck is supposed to follow.

Instructions: A polygon is a closed figure bounded by straight lines. The primary colors are red, blue and yellow. On the next screen, you will be shown a rule and four cards that have been drawn from this deck. One side of each card has the name of a shape, and the other side of each card has the name of a color. Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If there is a polygon on one side, then there is a primary color on the other side.
Switched Rule: If there is a primary color on one side, then there is a polygon on the other side.

Card Sets:

	P	~P	Q	~Q
1	Square	Line	Red	Black
2	Rectangle	Oval	Yellow	Pink
3	Diamond	Circle	Blue	White
4	Triangle	Heart	Blue	Purple

Total Number of Words: 171

Story

You are reading a children's story. In this story, the author starts talking about different fantastical creatures and the different types of food they eat. On the next page of the book, there are drawings of four cards with a different picture on each of them: a wug, a gug, crackers, and a carrot. Underneath these pictures, the author writes: Each of these cards has a picture of an animal on one side and a food item on the other side. You will be given a rule and I want you to check to see if the rule holds.

Instructions: On the next screen, you will be shown a rule and four cards. One side of each card has a picture of an animal (either a wug or a gug) and on the other side of each card, there is a picture of a type of food (either crackers or carrots). Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If the animal is a wug, then it eats carrots.
Switched Rule: If it eats carrots, then the animal is a wug.

Card Sets:

	P	~P	Q	~Q
1	Wug	Gug	Carrot	Crackers
2	Gary the Wug	Larry the Gug	Eating carrots	Eating crackers
3	A wug family	A gug family	Eating a bunch of carrots	Eating a box of crackers
4	A tiny wug	A tiny gug	Eating carrots	Eating crackers

Total Number of Words: 163

Story

You are playing with a very unusual deck of cards. It seems that one of your friends took certain cards from two different decks (a red deck and a blue deck) and put them together. While trying to figure out what your friend was doing, another friend comes along and suggests that only certain types of cards were drawn from one deck and different types of cards were drawn from another deck. You are not sure whether your friend is right or not, so you draw four cards randomly from the mixed-up deck to check.

Instructions: On the next screen, you will be shown the rule that your friend suggested and four random cards. One side of each card has the name of either a face card or a number card, and the other side of each card is either red or blue, Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If it is a face card, then it was from the blue deck.
Switched Rule: If it was from the blue deck, then it is a face card.

Card Sets:

	P	~P	Q	~Q
1	King of hearts	8 of diamonds	Blue deck	Red deck
2	Queen of spades	2 of clubs	Blue pattern	Red pattern
3	Jack of diamonds	5 of diamonds	Blue	Red
4	King of clubs	10 of spades	Blue deck	Red deck

Total Number of Words: 170

Story

You are playing with a very unusual deck of cards. It seems that one of your friends took certain cards from two different decks (a red deck and a blue deck)and put them together. While trying to figure out what your friend was doing, another friend comes along and suggests that only certain types of cards were drawn from one deck and a different type of cards were drawn from another deck. You are not sure whether your friend is right or not, so you draw four cards randomly from the mixed-up deck to check.

Instructions: On the next screen, you will be shown the rule that your friend suggested and four random cards. One side of each card has the name of either a red suited (hearts or diamonds) or a black suited (spades or clubs) card and the other side of each card is either red or blue, Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If it is a red suited card, then it was from the blue deck.
Switched Rule: If it was from the blue deck, then it is a red suited card.

Card Sets:

	P	~P	Q	~Q
1	King of hearts	8 of spades	Blue deck	Red deck
2	3 of hearts	2 of spades	Blue pattern	Red pattern
3	Jack of diamonds	5 of clubs	Blue	Red
4	Queen of diamonds	10 of spades	Blue deck	Red deck

Total Number of Words: 162

Story

You are examining a deck of 52 cards. Each card has a number on one side and a shape on the other. While you are looking through the cards, your friend tells you that only certain types of numbers and shapes can be on the same card. For example, if there is a certain type of number on the front of the card, then that determines what kinds of shape can be on the back. Your friend tells you one of the rules that the deck is supposed to follow.

Instructions: A polygon is a closed figure bounded by straight lines. On the next screen, you will be shown a rule and four cards that have been drawn from this deck. One side of each card has a number, and the other side of each card has the name of a shape. Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If there is an odd number on one side, then there is a polygon on the other side.
Switched Rule: If there is a polygon on one side, then there is an odd number on the other side.

Card Sets:

	P	~P	Q	~Q
1	13	6	Rectangle	Oval
2	41	42	Square	Circle
3	3	8	Triangle	Heart
4	11	16	Diamond	Line

Total Number of Words: 163

Story

You are examining a deck of 52 cards. Each card has a letter on one side and the name of a color on the other. While you are looking through the cards, your friend tells you that only certain types of letters and colors can be on the same card. For example, if there is a certain type of letter on the front of the card, then that determines what type of color can be on the back. Your friend tells you one of the rules that the deck is supposed to follow.

Instructions: The primary colors are red, blue and yellow. On the next screen, you will be shown a rule and four cards that have been drawn from this deck. One side of each card has a letter, and the other side of each card has the name of a color. Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If there is a consonant on one side, then there is a primary color on the other side.
Switched Rule: If there is a primary color on one side, then there is a consonant on the other side.

Card Sets:

	P	~P	Q	~Q
1	R	O	Red	Violet
2	N	E	Yellow	White
3	F	A	Blue	Pink
4	K	U	Yellow	Orange

Total Number of Words: 159

Story

You are examining a deck of 52 cards. Each card has the name of a color on one side and a number on the other. While you are looking through the cards, your friend tells you that only certain colors and numbers can be on the same card. For example, if there is a certain color on the front of the card, then that determines what kinds of numbers can be on the back. Your friend tells you one of the rules that the deck is supposed to follow.

Instructions: The primary colors are red, blue and yellow. On the next screen, you will be shown a rule and four cards that have been drawn from this deck. One side of each card has the name of a color, and the other side of each card has a number. Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If there is a primary color on one side, then there is an even number on the other side.
Switched Rule: If there is an even number on one side, then there is a primary color on the other side.

Card Sets:

	P	~P	Q	~Q
1	Yellow	Orange	4	3
2	Red	Purple	14	5
3	Blue	Black	8	9
4	Red	Pink	12	21

Total Number of Words: 146

Story

You are examining a deck of 52 cards. Each card has a word on one side and a number on the other. While you are looking through the cards, your friend tells you that only certain words and numbers can be on the same card. For example if the word on one side of the card has two syllables, then that determines what kinds of numbers can be on the other side. Your friend tells you one of the rules that the deck is supposed to follow.

Instructions: On the next screen, you will be shown a rule and four cards that have been drawn from this deck. One side of each card has a word, and the other side of each card has a number. Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If there is a two-syllable word on one side, then there is an odd number on the other side.

Switched Rule: If there is an odd number on one side, then there is a two-syllable word on the other side.

Card Sets:

	P	~P	Q	~Q
1	Letter	Dog	3	4
2	Lizard	Mail	7	8
3	Apply	Year	5	12
4	Credit	Tax	9	18

Total Number of Words: 146

Story

You are examining a deck of 52 cards. Each card has a word on one side and a number on the other. While you are looking through the cards, your friend tells you that only certain words and numbers can be on the same card. For example, if the word on one side of the card has two syllables, then that determines what kinds of numbers can be on the other side. Your friend tells you one of the rules that the deck is supposed to follow.

Instructions: On the next screen, you will be shown a rule and four cards that have been drawn from this deck. One side of each card has a word, and the other side of each card has a number. Indicate only those card(s) you definitely need to turn over to see if any of the cards violate the given rule.

Rule: If there is a two-syllable word on one side, then there is an even number on the other side.
Switched Rule: If there is an even number on one side, then there is a two-syllable word on the other side.

Card Sets:

	P	~P	Q	~Q
1	Enforce	Card	14	3
2	Color	Next	8	7
3	Tennis	Golf	12	5
4	Player	Chair	18	21

F.2 SCC

Total Number of Words: 192

Story

You are an auditor for the IRS. Your main job is making sure that people who try to take tax breaks are actually allowed to take them. Currently, you are going through the tax forms for people who are trying to take the Hope learning tax credit. To take this credit, you have to have taken at least one college course in the last year (to show that you are trying to further your education). After you go through the files, your supervisor will look at them as well. If you don't enforce the law and he catches you, you will be fired.

Instructions: On the next screen, you will be shown the regulation that you have been asked to enforce. The four cards on the next screen represent four people that have filed their tax forms. One side of the card tells you whether they applied for the Hope Learning tax credit and the other side tells you whether they have taken classes in the last year. Indicate only those card(s) you definitely need to turn over to see if any of these people are violating the rule.

Rule: If they apply for the Hope Learning tax credit, then they have taken classes within the last year.
Switched Rule: If they have taken classes in the last year, then they apply for the Hope Learning tax credit.

Card Sets:

	P	~P	Q	~Q
1	Applies for the tax credit	Does not apply for the tax credit	Has taken classes in the last year	Has not taken classes in the last year
2	Jill applies for the tax credit	Bob does not apply for the tax credit	Mary has taken classes in the last year	Jack has not taken classes in the last year
3	Mark asks for the tax credit	Vic does not ask for the tax credit	Becky has taken classes in the last year	Mark has not taken any classes in the last five years
4	Asks for the	does not ask for	Has taken classes	Has not taken classes for

tax credit	the tax credit	for the last two years	the last two years

Total Number of Words: 185

Story

You are a security guard at tennis club. Your job is to ensure that the members follow all the rules that are in effect at the club. One of the rules of the club is that the winner of a match has to buy the loser a drink. This is done to maintain a positive atmosphere at the club. Of course, some people don't like to follow this rule. If you fail to catch people who break this rule, other members of the club are sure to complain to the management and you will get fired.

Instructions: On the next screen, you will be shown the rule that you have been asked to enforce and some cards that have information about four of the players at the club. Each card represents one tennis player. One side of the card tells whether the player won their game, and the other side of the card tells whether they bought the other player a drink. Indicate only those card(s) you definitely need to turn over to see if any of the players violate the rule.

Rule: If a player wins a match, then he will treat the loser to a drink at the club's restaurant.
Switched Rule: If a player treats his opponent to a drink at the club's restaurant, then he won a match against them.

Card Sets:

	P	~P	Q	~Q
1	Won the game	Did not win the game	Paid for a round of drinks	Did not pay for a round of drinks
2	The player won the game	The player did not win the game	The player bought the drinks	The player did not buy the drinks
3	Won	Lost	Bought drinks	Didn't buy drinks
4	Won the game	Lost the game	Paid for drinks	Didn't pay for drinks

Total Number of Words: 187

Story

You have just been arrested for dealing drugs. The cops said they'd let you off if you spied on another drug dealer for them. You said yes just to get out of jail, but if they double-cross you, you'll make enemies and go to prison. You need to find out if the cops can be trusted. So, you pretend to be a reporter doing an article on police tactics and convince a neighboring police district to let you observe some interrogations. If these cops lie to any of their suspects, then the cops you talked to will almost certainly double-cross you.

Instructions: On the next screen, you will be shown the deal that the police offered the suspects (and you). The cards on the next screen have information about four other suspects at the station who have been arrested. One side of a card tells whether they agreed to spy, and the other side of the card tells whether the cops let him off. Indicate only those card(s) you definitely need to turn over to see if the police cheated any of the suspects.

Rule: If you spy on someone, then you will be released.
Switched Rule: If you are released, then you spied on someone.

Card Sets:

	P	~P	Q	~Q
1	Spied for the cops	Did not spy for them	Was released	Was not released
2	The suspect spied for the cops	The suspect did not spy for the cops	The suspect was released	The suspect was not released
3	Spied	Did not spy	The police did release him	The police did not release him
4	Spied for the police	Did not spy	The police did release him	The police did not release him

Total Number of Words: 179

Story

You are a guard at the Lonely Oaks Retreat located at high altitude in the Swiss Alps. The cabins that you guard are used as overnight shelters for the many hikers in the area. Since it is cold and firewood is not otherwise available at that altitude, the rule is that each hiker who stays overnight has to carry along his/her own share of wood. Your primary responsibility as the guard of the cabins is to make sure that everyone who stays overnight obeys the rule.

Instructions: On the next screen, you will be shown the rule that you have been asked to enforce. The cards on the next screen have information about four different hikers who are passing through the area. Each card represents one hiker. One side of the card tells whether or not they brought wood to the cabin, and the other side of the card tells you whether or not they stayed overnight at the cabin. Indicate only those card(s) you definitely need to turn over to see if any of the hikers violate the rule.

Rule: If you stay overnight in the cabin, then you bring a load of firewood up from the valley.
Switched Rule: If you bring a load of firewood up from the valley, you stay overnight in the cabin.

Card Sets:

	P	~P	Q	~Q
1	Stays overnight in the cabin	Does not stay overnight at the cabin	Carried wood	Carried no wood

2	Stays overnight	Did not stay overnight	Brought a load of wood	Did not bring a load of wood
3	Will stay at the cabin	Will not stay at the cabin	Carried a load of wood	Carried no wood
4	Stayed overnight	Did not stay overnight in the cabin	Carried a load of firewood	Did not carry a load of firewood

Total Number of Words: 228

Story

You are a member of the Namka, a hunter-gatherer culture living in the deserts of southwest Africa. The elders have entrusted you with the task of enforcer; it is your job to enforce the tribe's rules. Every full moon there is a special feast in which duiker (a small antelope) is eaten. Duiker meat is scarce and delicious -- a real treat, but it is reserved for warriors. For a young boy to become a warrior, they must find an ostrich eggshell. This is a sign that they have mastered the most difficult skills of hunting. To eat duiker meat without finding an ostrich eggshell is a big taboo for young boys. Your job is to make sure that none of the boys violate this rule. If you fail, it will affect the rest of their lives and you will be disgraced.

Instructions: On the next screen, you will be shown the rule that the elders have asked you to enforce. The cards on the next screen have information about four different boys. Each card represents one boy. One side of a card tells whether the boy has ever found an ostrich eggshell, and the other side of the card tells whether that boy took any of the roasted duiker meat. Indicate only those card(s) you definitely need to turn over to see if any of these boys have broken the law.

Rule: If you eat duiker meat, then you have found an ostrich eggshell.
Switched Rule: If you have found an ostrich eggshell, then you eat duiker meat.

Card Sets:

	P	~P	Q	~Q
1	Eats some duiker meat	Does not eat any duiker meat	Has found an ostrich eggshell	Has never found an ostrich eggshell
2	Eating duiker meat	Eating fox meat	Found an ostrich shell	Has only found quail shells
3	Eats duiker meat	Eats fox meat	Found an ostrich shell	Never found an ostrich shell
4	Eats some duiker meat	Does not eat any duiker meat	Has found an ostrich eggshell	Has only found robin shells

Total Number of Words: 232

Story

You are a Kaluame, a member of a Polynesian culture on the Maku island in the Pacific. The Kaluame have many strict laws which must be enforced, and the elders have entrusted you with enforcing them. On this island, there is a special type of food,

Cassava root, which is considered a powerful aphrodisiac. The elders have deemed that only married men may eat cassava root, because they disapprove of sexual relations between unmarried people, and distrust the intentions of bachelors. Cassava root is so powerful that many men are tempted to cheat on this law whenever the elders are not looking. If you fail to enforce this rule, you and your family will be disgraced.

Instructions: On the next screen, you will be shown the rule that the elders have asked you to enforce. The cards on the next screen have information about some young Kaluame men sitting in a temporary camp; there are no elders around. A tray filled with cassava root and other types of food has been left for them. Each card represents one man. One side of a card tells which food a man is eating and the other side of the card tells whether or not the man has a marriage tattoo on his face. Indicate only those card(s) you definitely need to turn over to see if any of these Kaluame men are breaking the law.

Rule: If a man eats cassava root, then he has a marriage tattoo on his face.
Switched Rule: If a man has a marriage tattoo on his face, then he eats cassava root.

Card Sets:

	P	~P	Q	~Q
1	Eats cassava root	Eats molo nuts	Tattoo	No tattoo
2	Eating cassava root	Not eating cassava root	Tattoo on face	No tattoo on face
3	Eating cassava root	Eating meat	Visible tattoo	No visible tattoo
4	About to eat cassava	About to eat molo	Has tattoo	Does not have tattoo

Total Number of Words: 284

Story

You are a Pacific Islander. There are many warring villages on your island. For example, Big Kiku is a warlord known for his ruthlessness. As a sign of loyalty, he makes his subjects put a tattoo on their face. Unfortunately, other tribes kill people with facial tattoos on sight. Even worse, your village has kicked you out and you are thinking of going to Big Kiku for help, but you do not know if you can trust him. You decide to watch him for a while to see how he treats others. While you are watching, four other men stumble into Big Kiku's village, starving and desperate. They have been kicked out of their villages and have come to him for food. Big Kiku makes a deal with each of them that he will exchange food for their loyalty. Big Kiku says that the tattoos must be in place tonight, but the food (cassava root) will not be available until the next morning. If you approach Big Kiku, he will give you the same deal, and if he cheats them, then he will certainly cheat you.

Instructions: On the next screen, you will be shown the deal that Big Kiku offered each of the men. The cards on the next screen have information about the fates of the four men. Each card represents one man. One side of a card tells whether or not the man went through with the facial tattoo that evening and the other side of the card tells whether or

not Big Kiku gave that man cassava root the next day. Indicate only those card(s) you definitely need to turn over to see if Big Kiku has cheated any of the four men.

Rule: If he got a tattoo on his face, then he got Cassava root.
Switched Rule: If he got cassava root, then he got a tattoo on his face.

Card Sets:

	P	~P	Q	~Q
1	Got the tattoo	No tattoo	Big Kiku gave him cassava root	Big Kiku gave him nothing
2	Got a tattoo	Did not get a tattoo	Got cassava root from Big Kiku	Got nothing from Big Kiku
3	Tattoo	No tattoo	Received cassava root	Received nothing
4	Went through with the tattoo	Did not go through with the tattoo	Received cassava root the next day	Received nothing the next day

Total Number of Words: 303

Story

You are the Peacemaker for your tribe. While most of your tribe gets along well, there are always some individuals who try to take advantage of others. Bo is a crafty old man in your tribe. He is always accidentally breaking his ostrich eggshells (which your people use to carry water) and would like to stockpile them. One morning, four men from neighboring bands come into camp. You notice that Bo approaches each man privately and offers him duiker meat for an ostrich eggshell. Bo claims that his wife is skinning the duiker today and that it won't be ready until tomorrow, but that he will need the eggshell this evening for his son, who is leaving tonight on a hunting expedition. Each man accepts Bo's offer. Because Bo has very little meat and a large family to feed, you believe that he will not honor his bargain. So you decide to spy on Bo to make sure that he doesn't try to cheat these men. If he does, the men will complain to the elders, and you will be disgraced for not enforcing the laws of the tribe.

Instructions: On the next screen, you will be shown the deal that Bo offered each of the men. The cards on the next screen have information about the four deals Bo made with these four men. What happened in one deal had no effect on the outcome of any other deal. Each card represents one man. One side of a card tells whether the man gave his ostrich eggshell to Bo that evening, and the other side of the card tells whether or not Bo gave that man meat the next day. Indicate only those card(s) you definitely need to turn over to see if Bo has cheated any of the four men.

Rule: If one of the men gives Bo his ostrich eggshell, then Bo gives them duiker meat.
Switched Rule: If Bo gives one of the men duiker meat, then they have given him their ostrich eggshell.

Card Sets:

P ~P Q ~Q

1	He gave his ostrich eggshell to Bo	He gave Bo nothing	Bo gave him meat	Bo gave him nothing
2	Bo received his ostrich eggshell	Bo received nothing	The man received meat from Bo	The man received nothing
3	Gave his eggshell to Bo	Gave nothing to Bo	Received meat	Received nothing
4	Bo received his ostrich eggshell	The man gave Bo nothing	Bo gave the man meat	Bo gave the man nothing

Total Number of Words: 250

Story

You are a spanner, an individual who can travel through time. It is very risky to time travel too far into the past or into the future. Because of this, a group of spanners have gotten together and created a list of rules to try to minimize the risk. You have been a spanner for quite a while and have a very good grasp of the rules and regulations. However, a lot of the novice spanners are really tempted to break the rules so that they can see what the year 3000 looks like, or meet famous historical figures. Recently, there have been a number of problems that the more experienced spanners have had to fix, at great personal cost. Therefore, they have asked you to enforce the rules of the group. This is a really big opportunity for you and if you do well, you could be given quite a few benefits. However, if you fail, your memories will be erased and your ability to travel through time taken away.

Instructions: The cards on the next screen have information about four novice spanners and the rule that you have been entrusted to enforce. Each card represents one spanner. One side of the card tells how long they have been a spanner and the other side of the card tells how far they traveled on their last trip through time. Indicate only those card(s) you definitely need to turn over to see if any of these spanners have violated the rules.

Rule: If you travel more than one year into the future, then you have been a spanner for more than one year.

Switched Rule: If you have been a spanner for more than one year, then you travel more than one year into the future.

Card Sets:

	P	~P	Q	~Q
1	Travels 2 years into the future	Travels 2 hours into the future	Been a spanner for 18 months	Been a spanner for 5 months
2	Travels 20 years into the future	Travels 4 months into the future	Been a spanner for 18 years	Been a spanner for 9 weeks
3	Travels 15 years into the future	Travels 4 days into the future	Been a spanner for over a year	Been a spanner for less than a year
4	Travels more than a year into the future	Travels less than a year into the future	Been a spanner for 5 years	Been a spanner for less than 5 days

Total Number of Words: 221

Story

You are a member of a secret organization called the AISB. To join this group, all potential members need to undergo the Rite of the Burning Sands. This ritual is very painful and leaves a very distinctive mark over the recipient's back. As painful as the rite was, you feel that it was worth it, because of all the perks you get. Now, it seems that some people are claiming to be members of the AISB when they actually aren't, and they are taking advantage of your hard-earned benefits. This is upsetting quite a few real members and they have asked you to stop them. If you succeed, they have promised to increase your status, but if you fail, they will kick you out of the group.

Instructions: On the next screen, you will be shown the rule that you have been asked to enforce. The cards on the next screen have information about four different people. Each card represents one person. One side of the card tells whether they are claiming to be a member of the AISB, and the other side of the card indicates whether or not they have undergone the Rite of the Burning Sands. Indicate only those card(s) you definitely need to turn over to see if any of these people are cheating the AISB.

Rule: If you are a member of the AISB, then you have undergone the Rite of the Burning Sands.

Switched Rule: If you have undergone the Rite of the Burning Sands, then you are member the AISB.

Card Sets:

	P	~P	Q	~Q
1	Says they are in AISB	Says they are not in AISB	Has undergone the rite of the Burning Souls	Has not undergone the rite of the Burning Souls
2	Jill claims to be in AISB	Bob has no clue what an AISB is	John has the scar from the rite of the Burning souls	Mary does not have any scars on her back
3	Becky: I'm in AISB	Bob: I'm not in AISB	Jill: I've undergone the rite of the Burning souls	John: I haven't undergone the rite of the Burning souls
4	In AISB	not in AISB	Scar from the rite	No scars at all

Total Number of Words: 255

Story

You are a member of the Timkut, a desert people who value enlightenment above all else. Before anyone is allowed to train for enlightenment, they have to voluntarily cut off one of their own fingers. This shows they have the strength and determination to devote their lives to the tribe. In exchange, the Enlightened are allowed to visit a sacred hut in your village. This hut is filled with delicious food and drink, and even valuables that the Enlightened may use. Unfortunately, there have been rumors that other members of the tribe are entering the hut, out of either curiosity or ill will. The leaders of the tribe have asked you to watch the hut to make sure that only the Enlightened go inside. If you succeed, they promise that they will let you train to become Enlightened which would greatly benefit both you and your family. If you fail, you will be disgraced, and you may even be expelled from the village.

Instructions: On the next screen, you will be shown the rule that you have been asked to enforce. The cards on the next screen have information about four different people who are walking near the hut. Each card represents one person. One side of the card tells whether they try to enter the hut and the other side of the card indicates whether or not they are missing a finger. Indicate only those card(s) you definitely need to turn over to see if any of these people are breaking the law.

Rule: If you enter the hut, then you are missing a finger.
Switched Rule: If you are missing a finger, then you enter the hut.

Card Sets:

	P	~P	Q	~Q
1	Tries to enter the hut	Walks past the hut	Missing a finger	Not missing a finger
2	Enters the hut	Goes past the hut	Missing their right pinky finger	has all ten fingers
3	Walks into the hut	Walks past the hut	Missing a finger	Not missing any fingers
4	Enters the hut	Does not enter the hut	Does not have all ten fingers	Has all ten fingers

Total Number of Words: 174

Story

You are an enforcer for the Hyperspace Clergy, who govern all interstellar travel. While hyperspace is much cheaper and faster than other methods of travel, too much use is destructive to the space-time continuum. However, many people do try to sneak through without clearance from the Clergy. Your job is to catch these criminals. If you succeed, your family will be given the privledge of traveling through hyperspace (saving you a lot of money), but if you fail, you will be fired and may even go to jail.

Instructions: On the next screen, you will be shown the rule that you have been asked to enforce. The cards on the next screen have information about four different ships. Each card represents one ship. One side of the card tells whether they try to enter hyperspace, and the other side of the card indicates whether or not they have clearance from the Clergy. Indicate only those card(s) you definitely need to turn over to see if any of these people are breaking the law.

Rule: In order to travel through hyperspace, you have clearance from the Clergy.
Switched Rule: If you have clearance from the Clergy, you travel through hyperspace.

Card Sets:

	P	~P	Q	~Q
1	Tries to enter hyperspace	Does not try to enter hyperspace	Has clearance	Does not have clearance
2	Enters hyperspace	Stays in regular space	Has clearance	No clearance
3	Tries to enter hyperspace	Stays in regular space	Has received clearance from the cleric	has never talked to the cleric
4	Enters hyperspace	Does not try to enter hyperspace	Has clearance	Never got clearance

Total Number of Words: 176

Story

You are a Florida state patrolman. Like many other states, the Florida freeways devote the left lane to individuals who choose to carpool. These carpool lanes, often called High Occupancy Vehicle (HOV) lanes, are set aside in an attempt to encourage people to carpool more often. In addition to helping the environment, if more people carpooled it might lesson the congestion in other lanes. Your job is to make sure that only people who are carpooling are driving in the HOV lane. Otherwise, drivers who are following the law will call in to complain and you may get fired for not doing your job.

Instructions: Your job is to enforce the law given on the next screen. The four cards on the next screen represent four different cars that are on the freeway. One side of the card tells who is in the car and the other side tells you which lane they are driving in. Indicate only those card(s) you definitely need to turn over to see if any of these drivers are breaking the law.

Rule: If you are driving in the HOV lane, then you have more than one person in your car.
Switched Rule: If you have more than one person in your car, then you drive in the HOV lane.

Card Sets:

	P	~P	Q	~Q
1	In the HOV lane	In the far right lane	3 people in the car	1 person in the car
2	Merging into the HOV lane	In the middle lane	5 people in the car	Only one person in the car
3	Driving in the HOV lane	Driving in a non-HOV lane	Two people in the car	Just the driver in the car
4	Riding in the HOV lane	Riding in the right lane	An entire family in the car	Just one person in the car by themselves

Total Number of Words: 179

Story

You are a privately hired security guard for TicketMaster, a corporation that sells concert tickets. Your job is to maintain order during ticket sales. This morning at 8:00 am, TicketMaster started selling tickets for a very popular group. The biggest security problem that the company has is with people cutting in line. While it may not seem like a big deal initially, when people start cutting in line it starts to upset the other patrons and it has even led to riots in the past. If any riots start, or even if anyone cuts in line, you will be fired for not doing your job.

Instructions: Your job is to enforce the rule given on the next screen. In addition, the four cards on the next screen represent four different people that are standing in line. One side of the card tells where they are in line and the other side tells you what time they arrived. Indicate only those card(s) you definitely need to turn over to see if any of these people are violating the rule.

Rule: If a person A is ahead of person B in line, then person A got there before person B.
Switched Rule: If person A got there before person B, then person A is ahead of person B in line.

Card Sets:

	P	~P	Q	~Q
1	1st in line	Last in line	Got here 1st	Got here last
2	2nd in line	31st in line	Got here very early	Got here very late
3	5th in line	Last in line	Got here 5 minutes after opening	Got here 5 minutes ago
4	Near the front of the line	Near the end of the line	Got here fairly early	Got here fairly late

Total Number of Words: 182

Story

You are head of the internal affairs division for your company. Your main job is to ensure that any hiring processes that go on in your company follow federal regulations. Namely, that everyone is given an equal opportunity to apply and that your company

does not hire anyone who is not qualified. Your company requires that anyone who is promoted has to have at least a Masters degree. Unfortunately, there are many people in the company who are tempted to just promote their friends. Your job is to make sure that they follow the rules. Otherwise, you will be fired and you may even be held liable for violating federal regulations.

Instructions: On the next screen is the policy that you have to enforce. The four cards on the next screen represent four different people in your company. One side of the card tells whether they are getting a promotion and the other side tells you their education level. Indicate only those card(s) you definitely need to turn over to see if any of these people are being promoted against the rules.

Rule: If someone is promoted, then they have at least a Masters degree.
Switched Rule: If someone has at least a Masters degree, then they can be promoted.

Card Sets:

	P	~P	Q	~Q
1	Alice gets promoted to Manager	Bill does not get promoted for manager	Vic has a Masters degree in Engineering	John has an Associates degree
2	Gets nominated for a promotion	Doesn't get nominated for a promotion	Has a Doctorate degree	Has a Bachelors degree
3	Jack gets promoted to Project lead	Dana does not get promoted to Project Lead	Mary has a Masters degree	Ann does not have a Masters degree and Bill does
4	Is notified that he is going to be promoted	Is notified that he can't be promoted	Got his Masters degree at Yale	Never finished college

Total Number of Words: 157

Story

At your university, they give a discount to drivers who show up before 8am at the pay parking lots. You are head of the parking lots at the university and you have been getting complaints that some people who enter after 8:00 am are being given the discount rate of $1.50, instead of having to pay the normal rate of $4.00. A lot of the students are getting very upset about this, and you will lose your job if it happens again.

Instructions: On the next screen, you will be shown the rule that you have been asked to enforce. The four cards on the next screen represent four people that are parked in the pay parking lots. One side of the card tells what rate they paid and the other side tells you what time they arrived. Indicate only those card(s) you definitely need to turn over to see if any of these people are violating the rule.

Rule: If they pay the reduced rate, then they got there before 8am.
Switched Rule: If they got there before 8am, then they pay the reduced rate.

	P	~P	Q	~Q
1	Jill paid $1.50	Bob paid $4.00	Mary got there at 7:30am	John got there at 8:30am
2	Paid the reduced rate	Paid the normal rate	Got there before 8am	Got there after 8am
3	Bill was asked to pay $1.50	Gary was asked to pay $4.00	Max got there at 6am	Aaron got there at noon
4	Mark was asked to pay the reduced rate	Becky was asked to pay the normal rate	Bridget got there at 7am	Sam got there at 1pm

Appendix G: Materials for Physiological Stage

G.1 WST Stories

Familiar Condition

Total number of words: 584
Story 1:
You recently got a new job at the American Heart Association (AHA) in the investigative branch. Because the AHA's goal is to create a healthier America, they want more restaurants to offer heart friendly low-fat alternatives to pizza and cheeseburgers. For restaurants that comply, the AHA will allow them to put the AHA stamp of approval next to the item on the menu. Recent marketing research has shown that having the stamp increases sales by quite a bit. \n\tSubway claims that their sub sandwichs have less than 6 grams of fat and is therefore eligible for the AHA stamp of approval. However, it has been rumored that some restaurants have been underestimating the fat content of some of their menu items just to get the stamp and to boost sales. Your job at the AHA is to go to Subway and check the fat content of all of their sub sandwiches to make sure that they have not been cheating the AHA just to get the stamp of approval. This is your first assignment and if you succeed then you will get a raise, but if you fail you be fired.

Instructions: On the following screen you will be presented with the rule that the AHA has asked you to follow. The cards on the next screen have information about four different Subway sandwiches. Each card represents only one sandwich. One side of the card tells you whether or not the sandwich has been AHA certified, and the other side of the card tells you the number of grams of fat in the sandwich. Indicate only the card or cards you definitely need to turn over to see if Subway has lied to the AHA and certified unhealthy menu items.

Rule: If the item is AHA certified, then it has less than 6 grams of fat.

Total number of words: 544
Story 2:
The University Cancer Prevention Society has been pressuring the university to create new policies to decrease student smoking. To appease the group the regents of the university recently issued a rule that all smokers must stand 25 feet away from all dorm buildings while smoking. The rule is intended to keep second hand smoke from entering the building. However, many of the students have still been smoking right next to the building. You have been hired as a security guard to monitor the dorm buildings around campus to make sure that all of the smokers are abiding. Because you are a new employee, you run the risk of being fired if you do not do your job well. Your boss has warned you that he will not tolerate incompetence, and that if he sees any people smoking close to the buildings, he is going to blame you and you will be held accountable. It is very important to you that you keep your job, so you want to do it well.

Instructions: On the next screen, you will be shown the new rule that you have been instructed to enforce. The cards on the next screen have information about four people that are standing around a dorm building. Each card represents only one person. On one side of the card it tells whether or not the person is smoking a cigarette, on the other side it tells the distance, in feet, that the person is away from the building. Indicate only the card or cards you definitely need to turn over to see if any of the students are breaking the smoking ordinance.

Rule: If the student is smoking, then they are 25 ft away.

Total number of words: 568
Story 3:
You are one of Santa's elves. Santa is getting old and can no longer keep track of all the children in the world. He has developed a new method to determine which children should get presents in their stockings and which children should get coal: Instead of checking his list, he now just asks the children to write down on the top of their wish list whether they have been naughty or nice. However, he now believes that some of the children may have lied and put nice on the top of their wish list just to get presents! Santa has given you the job of making sure that none of the children are lying. Your plan is to ask the children's parents whether their kids have been naughty or nice, and then find out whether or not they received presents. It is important that you fulfill your role or Santa might get a new elf to do your job. You would then be demoted back into the toyshop, which has long hours and no health care!

Instructions: On the next screen, you will be shown the rule that Santa Claus has asked you to enforce. The cards on the following screen have information about four different children. Each card represents just one child. One side of a card tells whether the child's parents said that their child had been naughty or nice and the other side of the card tells whether the child received presents in their stocking or whether they received coal or no presents at all. Indicate only the card or cards you definitely need to turn over to see if any of these children have lied to Santa.

Rule: If the child received presents, then he/she had been nice.

Total number of words: 520
Story 4:
The school board of a local senior high has decided that only seniors will be allowed to attend this year's prom. This new rule has been created because, at last year's prom, a large group sophomores and juniors snuck in through the back door and tried to crash the party. Some of the seniors tried to stop them and a very large fight broke out. A chair was broken over someone's back and two student had to get stitches. Afterwards, some of the parents threatened to sue the school over it! To avoid the threat of lawsuits, the school board decided that no one who is not a senior will be allowed to attend prom, even if they

are dating a senior. The principle has hired you to make sure that last year's... unpleasantness does not happen again. If you fail, you will not only be fired, but you may also be sued right along with the school!

Instructions: On the next screen, you will be shown the rule that the principal has asked you to enforce. The cards on the next screen have information about four different students that attend the high school. Each card represents only one student. One side of a card tells whether or not the student is going to the senior prom and the other side tells whether or not the student is a senior. Indicate only the card or cards you definitely need to turn over to see any students are trying to break the new rule and sneak into prom!

Rule: If you attend prom, then you are a senior.

Total number of words: 597
Story 5:
The key to training an animal is continuous reinforcement. Any time you see your dog rotate 360 degrees, you grab a milk bone and make his day! There's just one problem: your roommate. You suspect that she's been giving the dog treats any time it begs. That might win her a canine friend, but it's really sabotaging your efforts. You need to get her to help with the training, but she can be... touchy about this sort of thing. You're worried that if you mention it and she hasn't been feeding the dog, she'll get mad and do something rash, like move out! Since she pays most of the rent, you can't really afford to tick her off. So, you go to the store and pick up the cheapest nanny-cam you can find. You set it up in the kitchen so it has a clear view of the living room and the kitchen cabinet where you keep the milkbones. You let it run for a couple of days (during which time the dog makes absolutely no progress) and then examine the footage...

Instructions: On the next screen, you will be shown the rule that you have told your roommate to follow. Since you don't have time to view all of the videos, you decide just to check certain parts. The cards on the next screen have information about four different times on the video. Each card represents only one period of time. One side of a card tells whether or not your roommate gave the dog a treat and the other side tells whether or not the dog rolled over. Indicate only the card or cards you definitely need to turn over to see if your roommate is breaking the rule

Rule: If your roommate gives your dog a treat, then he rolled over.

Total number of words: 520
Story 6:
You are a network manager on a large computer network servicing a corporation that specializes in defense contracting. Your primary job duty is to ensure that only users with the proper access level are allowed to download sensitive data. The information that you safeguard is incredibly valuable, ranging from research data to computer models of top-secret prototypes. If a rival company or government were to get their hands on it,

your company would be ruined! One of the tools you use to monitor this data is a network scan that keeps track of everyone who downloads files from the system. It is important that you keep an eye on these users since there have been recent reports of hackers breaking into high profile systems by cracking their passwords. If you fail to catch someone stealing information, not only will you be fired, but you will never be able to work in security again.

Instructions: On the next screen, you will be shown the rule you have been asked to enforce. The cards on the next screen have information about four users who are logged onto the computer system that you safeguard. One side of the card tells whether the user has a high access level or a low access level, while the other side of the card tells what sort of file the user is downloading (a sensitive file or a normal, public file). Indicate only the card or cards you definitely need to turn over to see if any of the users are illegally downloading data from your system.

Rule: If the user downloads sensitive files, then they have high-level access.

Total number of words: 540

Story 7:

A small furniture making business specializes in custom furniture. Recently, they decided that they wanted to make sure that their products were the best in town so they changed their business procedure. Instead of paying each employee by the hour, it was decided that the employees would only get paid if the customers were satisfied with what was made for them. Each customer was asked to fill out a questionnaire upon receiving their customized product and mail it back. At the end of every week each employee was asked to determine how many customers were satisfied with their purchase and they would get paid accordingly. It was suspected, however, that some employees were changing the opinions on their questionnaires to increase satisfaction and therefore get paid more. Your job is to call the customers to make sure that the employees aren't lying to get paid more. Unfortunately, your pay depends on how happy you make the manager of the company. If you don't catch everyone who is cheating, the manager won't be satisfied and you won't get paid.

Instructions: On the next screen, you will be shown the rule that the your manager has told you to enforce. The cards on the next screen have information about four different employees. Each card represents only one employee. One side of a card tells whether or not the customer said they were satisfied and the other side tells whether or not that employee got paid. Indicate only the card or cards you definitely need to turn over to see if any employees cheated at the end of the week.

Rule: If the employee got paid, then the customers were satisfied.

Total number of words: 530

Story 8:

The tire swing at Jesse Jackson Elementary is only big enough for one person to ride it at a time. Understandably, competition during recess can get pretty intense, but this year something interesting happened. One of the kids came up with a rule that you could only ride the tire swing if you'd already pushed someone else: one ride for one push. The idea spread through the school like a case of the flu (and let me tell ya, that's fast!), and now the kids enforce it on their own. It's like watching cave men discover fire (if by fire you mean the basic principles of economics, anyway). Most of the kids follow the rule, but the couple of times they haven't massive schoolyard brawls have started. Last time one of the kids had their nose broken. It is your job to watch the kids during recess and after last time, the school board made very clear that they are going to hold you responsible if it happens again.

Instructions: On the next screen, you will be shown the rule that governs the use and sharing of the tire swing. The cards on the next screen have information about four different children. Each card represents only one child. One side of a card tells whether or not the child pushed another child on the swing and the other side tells whether or not that child rode the tire swing. Indicate only the card or cards you definitely need to turn over to see if any of the children are violating the rule.

Rule: If the child rides the tire swing, then they have pushed someone else on it.

Total number of words: 552

Story 9:

You are a tax auditor for the IRS. Your main job for the IRS is making sure that people who try to claim tax deductions on their tax forms are actually eligible for those deductions. Unfortunately, a lot of people either don't understand their taxes or try to cheat the government. Currently, you are going through the extensive tax forms for four different people who are trying to take the Hope Learning tax credit. This credit is only for individuals who are trying to further their education, while working. To be eligible for the Hope Learning tax credit, you need to have taken at least one college course within the last year. You need to make sure that each of these four people are not trying to take the deduction illegally. After you go through these files, your supervisor will also look at them to see how well you did. You've made some mistakes in the past, so this time your supervisor told you that if you make one more mistake, you will be fired.

Instructions: On the next screen, you will be shown the regulation that your boss has asked you to enforce. The four cards on the next screen gives you information about the tax forms for four different people. Each card represents one person. One side of the card tells you whether or not they applied for the Hope Learning tax credit and the other side tells you whether or not they have taken classes in the last year. Indicate only the card or cards you definitely need to turn over to see if any of these people are violating the rule.

Rule: If they apply for the Hope Learning tax credit, then they have taken classes within the last year.

Total number of words: 554
Story 10:
You are a security guard for a local tennis club. The club that you work at is very popular, because it is such a friendly environment. However, the only reason that this club is so friendly is because the owners have established very strict rules regarding etiquette. Your job at this club, is to make sure that all of the members follow all of the club's rules For example, to help maintain a positive atmosphere at the club, winners of matches are supposed to buy the losers a drink at the bar. This is supposed to make sure there are no hard feelings. Unfortunately, some people don't like to follow this rule, because they dislike their opponent and don't like being friendly to them. However, if this happens, the club will lose a lot of its business and the owners will be very mad at you. In fact, if you fail to catch people who break this rule, other members of the club are sure to complain to the management and you will get fired.

Instructions: On the next screen, you will be shown the rule that you have been asked to enforce at the club. In addition, you will be shown four cards that have information about four of the players at the club. Each card represents one tennis player. One side of the card tells whether or not the player won their game, and the other side of the card tells whether or not they bought the other player a drink. Indicate only the card or cards you definitely need to turn over to see if any of the players violate the rule.

Rule: If a player wins a match, then he will treat the loser to a drink at the club's restaurant.

Total number of words: 552
Story 11:
You have just been arrested for dealing drugs. It was your first time and it was only because you needed the money. The cops who arrested you said that they would let you off this time, if you spied on another drug dealer for them. You were pretty scared at the time, so you agreed. However, now that you are out of the interrogation room, you are not sure if you can trust them. Spying on some of the other drug-dealers is really risky, if they find out, they will kill you for sure. And if the cops double-cross you, not only will you have made enemies, but you will go to jail. So, you need to find out if the cops can be trusted. You pretend to be a reporter doing an article on police tactics and convince a neighboring police district to let you observe some of their interrogations of small time drug dealers. If these cops lie to any of their suspects, then the cops you talked to certainly lied to you.

Instructions: On the next screen, you will be shown the deal that the police at the neighboring station offered their suspects (and the same deal that was offered to you). The cards on the next screen have information about four other suspects at the station

who have been arrested. One side of a card tells whether or not they agreed to spy, and the other side of the card tells whether or not the cops let him off. Indicate only the card or cards you definitely need to turn over to see if the police cheated any of the suspects.

Rule: If you spy on someone, then you will be released.

Total number of words: 550
Story 12:
You are a security guard at the Lonely Oaks Retreat in the Swiss Alps. The cabins that you guard are used as overnight shelters for the hikers that pass through. While the cabins are very nice, they can only be heated through the fireplace. However, it is often hard to find firewood near the cabins, so the hikers are supposed to bring their own firewood to use. All of this wood is stored in a large woodpile behind the cabin and those who stay overnight take the wood as they need it. Your primary responsibility as the guard of the cabins is to make sure that everyone who stays overnight at the cabins has brought their own wood. Recently, you have gotten complaints that people who haven't brought wood with them are seen taking wood from the woodpile, leaving others to spend quite a bit of the night in the cold. The managers of the cabin are understandably upset and have told you that your job depends on making sure that this never happens again.

Instructions: On the next screen, you will be shown the rule that you have been asked to enforce. The cards on the next screen have information about four different hikers who are passing through the area. Each card represents one of these hikers. One side of each card tells whether or not the hiker brought wood up to the cabin, and the other side of the card tells you whether or not they stayed overnight at the cabin. Indicate only the card or cards you definitely need to turn over to see if any of the hikers violate the rule.

Rule: If you stay overnight in the cabin, then you bring a load of firewood up from the valley.

Total number of words: 548
Story 13:
You are a Florida state patrolman. Like many other states, the Florida freeways devote the left lane to individuals who choose to carpool. These carpool lanes, which are often called High Occupancy Vehicle (HOV) lanes, are set aside in an attempt to encourage people to carpool more often. The purpose of the HOV lanes is to try to reduce car pollution in high traffic areas. In addition to helping the environment, if more people carpooled it might lesson the congestion in other lanes. While you may have many tasks to do, your job as a patrolman is to make sure that only people who are carpooling are driving in the HOV lane. Recently, your department has gotten a lot of complaints from other drivers, that single drivers are using the car pool lanes. Your boss, is upset about having to field all of these disgruntled drivers. Unfortunately, he is taking it out on you. He told you that if you get one more complaint, about an area that you are patrolling, you will be fired.

Instructions: On the next screen, you will be shown the law that you have been instructed to enforce. The four cards on the next screen represent four different cars that are driving on the Florida State freeway in the area that you are patrolling. One side of each of the cards tells how many people are in the car and the other side of each of the cards tells you which lane the car is driving in. Indicate only the card or cards you definitely need to turn over to see if any of these drivers are breaking the law.

Rule: If you are driving in the HOV lane, then you have more than one person in your car.

Total number of words: 548
Story 14:
You are a privately hired security guard for TicketMaster, a corporation that sells concert tickets. TicketMaster hired you because they are having problems maintaining order during ticket sales. The biggest problem they have is with people cutting in line and then buying huge quantities of tickets. This leads to people who arrived early not being able to get any tickets and being very upset. Quite a few of them have called and complained to the media, which is causing the company to get very bad press. Unfortunately, the company has more to worry about than bad press. Last month, this situation led to a riot, as people became infuriated with the lack of order. Now there are lawsuits being raised and the cops are quite upset. This morning at 8am, TicketMaster started selling tickets for a popular group. There is going to be a lot of press around. Your job is to make sure that no one cuts in line. If anyone does cut, it will be caught on tape and you will be fired.

Instructions: On the next screen, you will be shown the exact rule that you have been hired by TicketMaster to enforce. In addition, the four cards on the next screen represent four different people that are currently standing in the line. Each card represents one person. One side of each of the cards tells where they are in line relative to others and the other side of each card tells you what time they arrived in line. Indicate only the card or cards you definitely need to turn over to see if any of these people are violating the rule.

Rule: If a person A is ahead of person B in line, then person A got there before person B.

Total number of words: 556
Story 15:
Over the last few months your company has had a number of scandals. All of them arose from complaints that your company wasn't hiring or promoting people fairly. It turns out that many of the managers were just hiring their family members even though they weren't qualified for the job. Because of this a lot of people got fired and your company was fined a lot of money. In addition to the managers that were fired, the head of the internal affairs division was also fired for letting this sort of behavior go on. You are his replacement. Your main job is to ensure that any hiring processes that go on in your

company follow federal regulations. Namely, that everyone is given an equal opportunity to apply and that your company doesn't hire anyone who is not qualified. Your company requires that anyone who is promoted has to have at least a Masters degree (PhDs are OK). If you don't make sure that only qualified people are hired, you will be fired from your job.

Instructions: On the next screen you will be shown the policy that you have been hired to enforce. The four cards on the next screen represent four different people who work for your company and who might be coming up for promotion in your company. One side of each of the cards tells whether or not they are getting a promotion and the other side tells you what their current education level is. Indicate only the card or cards you definitely need to turn over to see if any of these people are being promoted in violation of the rules.

Rule: If someone gets promoted, then they have at least Masters degree.

Total number of words: 556
Story 16:
You work at a local university. At your university, they give a price discount to drivers who arrive at the pay parking lots before 8am. The reason for this is to try to encourage drivers to come at off times, so that there is less of a backup during the busy times. You have recently been hired by the University's Transportation Services department to maintain and run their parking lots. As head of the parking lots at the university, you have been getting more and more complaints that some people who get to the parking lots after 8am are being given the early-bird discount rate of $1.50, instead of having to pay the normal rate of $4.00. This has become such a problem, that a lot of the students are complaining to the campus paper and they are starting to run stories on the problem. Even worse, they are complaining to your manager. He tells you that you have to fix this problem, and you will lose your job if he hears of another complaint.

Instructions: On the next screen, you will be shown the rule that you have been told to enforce. The four cards on the next screen represent four people that are currently parked in the pay parking lots. Each card has information about a different car that is at the lot. One side of each card tells what rate the person paid to get in and the other side tells you what time they arrived at the lot. Indicate only the card or cards you definitely need to turn over to see if any of these people are violating the rule.

Rule: If they pay the reduced rate, then they got there before 8am.

Total number of words: 522
Story 17:
You're a poor college student, living off of your meager student loans, so you take your gift-giving very seriously. It's your birthday and you're throwing a party for yourself, but it's a sound investment: all your friends are here and they're bringing you nice, valuable

presents. You've been mingling for quite a while and the gift table is getting good and crowded. You head over to check it out and, after a quick head count, you realize that there are more guests than gifts. At first, you're upset. This party set you back a few and some of your supposed friends are freeloading! Then, you realize that you didn't buy presents for ALL of your friends over the last year. Some might not think you expected gifts from them. You start going over the last year in your mind, trying to remember who you gave presents to and then checking to make sure they brought you a gift in return.

Instructions: On the next screen, you will be shown the rule that you want to enforce. The four cards on the next screen represent four people that came to your party. Each card has information about a different person that is there. One side of each card tells whether or not that person brought you a present and the other side of the card tells whether you got them a present. Indicate only the card or cards you definitely need to turn over to see if any of these people are cheating you.

Rule: If they got a present at their party, then they give you one today.

Total number of words: 516
Story 18:
To win in horse racing, jockeys often have a very rigourous schedule for practice. Each jockey must be a standard weight, be strong, agile, and fit in order to be successful. On average, each jockey practices a minimum of 2-3 hours per day during the racing season. Recently, there has been evidence that some jockeys were cheating in order to be in top shape by taking drugs instead of practicing. Owners of the race track and track officials soon found out and decided that whoever was involved in these acts would be suspended and possibly permanently banned from the track. Last month the jockeys took drug tests and some of them were suspended. But now, it's come out that the previous examiner had been paid off by some of the jockeys, so now you have to come in and redo all the tests. The previous examiner ended up getting fired and fined. If you fail to catch the jockeys who are cheating, the same will happen to you.

Instructions: On the next screen, you will be shown the regulation that the track officials have asked you to enforce. The four cards on the next screen represent four different jockeys. Each card represents one person. One side of the card tells you whether or not they used the illegal drug and the other side tells you whether or not they got suspended from the track. Indicate only the card or cards you definitely need to turn over to see if any of these jockeys needed to be suspended.

Rule: If the jockey took illegal drugs, then they were suspended.

Unfamiliar Condition

Total number of words: 554
Story 19:
You are a member of the Namka, a hunter-gatherer culture living in the deserts of southwest Africa. Because of your braveness in battle, the elders have entrusted you with the task of enforcing the tribe's rules. The most important of these rules occurs every full moon when there is a very special feast in which duiker (a small antelope) is eaten. Duiker meat is scarce and delicious-a real treat, but only warriors are allowed to eat it. For young boys to become a warrior, they have to find an ostrich eggshell. Since ostrich eggshells are very difficult to find and hard to bring back intact, finding one is a sign that they have mastered the most difficult skills of hunting. To eat duiker meat without finding an ostrich eggshell is a big taboo for young boys, it symbolizes laziness and cowardice. Your job is to make sure that none of the young boys in your tribe violate this rule. If you fail, it will affect the rest of their lives and you will be disgraced.

Instructions: On the next screen, you will be shown the rule that the elders have asked you to enforce. The cards on the next screen have information about four different boys. Each card represents one boy who is approaching the table of duiker meat. One side of a card tells whether the boy has ever found an ostrich eggshell, and the other side of the card tells whether that boy took any of the roasted duiker meat. Indicate only the card or cards you definitely need to turn over to see if any of these boys have broken the law.

Rule: If you eat duiker meat, then you have found an ostrich eggshell.

Total number of words: 548
Story 20:
You are a Kaluame, a member of a Polynesian culture on the Maku island in the Pacific. As a Kaluame, your tribe has many laws which to be enforced. The elders have entrusted you with enforcing the rules. On this island, there is a special type of food, Cassava root, which is considered to be a powerful aphrodisiac. Because of its fabled powers of seduction, the elders have deemed that only married men may eat cassava root, because they disapprove of sexual relations between unmarried people, and distrust the intentions of bachelors. They feel that sexual relations between unmarried people would diminish the stability of the group. Despite these worries, many men are tempted to cheat on this law whenever the elders are not looking, because it is a powerful aphrodisiac. Marriage is very important to your tribe, when men marry they get a marriage tattoo on their face that can be easily seen. Enforcing this rule is your primary responsibility. If you fail to enforce this rule, you and your family would be disgraced.

Instructions: On the next screen, you will be shown the rule that you have to enforce. The cards have information about some Kaluame men sitting in a camp by themselves. A tray with cassava root and other types of food has been left for them. Each card

represents one man. One side of each card tells which food a man is eating. The other side tells whether or not he has a marriage tattoo on his face. Indicate only the card or cards you definitely need to turn over to see if any of these men are breaking the law.

Rule: If a man eats cassava root, then he has a marriage tattoo on his face.

Total number of words: 552
Story 21:
You are a Pacific Islander. There are many warring villages on your island. For example, Big Kiku is a warlord known for ruthlessness. As a sign of loyalty, he makes his subjects put a tattoo on their face. Unfortunately, other tribes instantly kill people with facial tattoos. Your village has just kicked you out and you are thinking of going to Big Kiku for help, but you don't know if you can trust him. You decide to watch him to see how he treats others. While watching, four other men stumble into Big Kiku's village, starving and desperate. They have been kicked out of their villages and have come to him for food. Big Kiku makes a deal with each of them that he will exchange food for their loyalty. Big Kiku says that they must have the tattoos by tonight, but the food (cassava root) will not be available until the next morning. If you approach Big Kiku, he will give you the same deal. If he cheats them, then he will cheat you.

Instructions: On the next screen, you will be shown the deal that Big Kiku offered each of the four men. The cards on the next screen have information about their fates. Each card represents one man. One side of a card tells whether or not the man went through with the facial tattoo that evening and the other side of the card tells whether or not Big Kiku gave that man cassava root the next day. Indicate only the card or cards you definitely need to turn over to see if Big Kiku has cheated any of the four men.

Rule: If he got a tattoo on his face, then he got Cassava root.

Total number of words: 554
Story 22:
You are the Peacemaker for your tribe. While most of your tribe gets along well, there are some people who take advantage of others. Bo is one such individual in your tribe. He is always accidentally breaking his ostrich eggshells (used to carry water) and likes to stockpile them. One morning, four men from neighboring bands come into camp. You notice that Bo approaches each man privately and offers him duiker meat for his eggshell. Bo claims that his wife is skinning the duiker today, so it won't be ready until tomorrow. However, he will need the eggshell this evening for his son, who is leaving tonight on a hunting expedition. Each man accepts Bo's offer. Because Bo has very little meat and a large family, you believe that he will try to cheat these men. You decide to spy on Bo to make sure that he doesn't try to cheat them. If he does, the men will complain to the elders, and you will be disgraced for not enforcing the laws of the tribe.

Instructions: The next screen shows the deal that Bo offered each of the men. Each card has information about the deal that Bo made with the men. What happened in one deal had no effect on the outcome of any other deal. One side of each card tells whether or not the man gave his eggshell to Bo and the other side of the card tells whether or not Bo gave that man meat the next day. Indicate only the card or cards you definitely need to turn over to see if Bo has cheated any of the four men.

Rule: If one of the men gives Bo his ostrich eggshell, then Bo gives them duiker meat.

Total number of words: 568
Story 23:
You are a member of an alien civilization on the planet Zorton. Your alien species looks a lot like humans except you are green and have six legs. Because your species has so many feet, there is a large market for footwear. You recently got a new job as the quality assurance supervisor at a sock factory. This factory has only two assembly lines. Both assembly lines package socks, but assembly line A puts them in groups of 6, while line B puts them in groups of 12. Since line B makes more socks more quickly, they often get done earlier and are considered to have the easier job. Unfortunately, this extra bonus doesn't seem to be enough for some of the workers. It has been suspected that some employees that work on line B have been making packages with only 6 socks and then stealing the rest. Your job is to make sure that employees are not cheating the company by stealing socks. If you fail to stop employee theft you will be fired and forced to pay for all socks that were stolen under your watch.

Instructions: On the next screen you will be shown the rule that your boss instructed you to enforce. The cards below the rule have information about four different employees that work on the assembly lines. Each card represents only one employee. One side of the card tells whether they work on line A or line B. The other side of the card indicates the number of socks they put in each package. Indicate only the card or cards you definitely need to turn over to see if any of the employees are stealing from the company.

Rule: If the employee works on Line B, then they must package 12 socks.

Total number of words: 552
Story 24:
You are a member of the Taquala-Tagua tribe. Every year during harvest season all of the men must march up to the terraced fields to harvest the quinoa, a high-protein grain. Because the fields are ten miles away from the village, the men set up camp and stay until the harvest is complete. Each day a burro is sent back bearing food from the married men to sustain their families back at the village. The men that are not married do not need to send anything back and may just eat the food they harvest. However, it has been rumored that some married men have been letting their families go hungry. They have been eating their share of the harvest by themselves and sending the burro away without attaching a package of food. The chief of the tribe has given you the job of ensuring that all the

married men send food back to their families. If you fail to enforce this rule, then you will be forced to feed the families with your food and you will be disgraced.

Instructions: On the next screen you will be shown the rule you have been instructed to enforce. The cards beneath the rule have information about four different men that are present at the harvest. Each card represents one man. One side of the card tells whether or not they are putting a package of food on the burro and the other side of the card indicates whether or not they are married. Indicate only the card or cards you definately need to turn over to see if any of these people are violating the rule.

Rule: If the man is married, then he puts a package on the burro.

Total number of words: 540
Story 25:
You are a member of a hidden mermaid and mermen civilization that lives deep beneath the Pacific Ocean. Your entire civilization is vegetarian, so you only eat the algae that float along the surface. The merpeople are afraid that humans will discover them and put them on display in a zoo, so they live their lives in secret and are very cautious when going up to the surface to harvest algae. All merpeople that are involved in the harvest are required to complete an ocean surface safety course and obtain a harvesting license before they are allowed to go within 300 feet of the surface. However, a group of merpeople has recently been traveling near the surface to try to get a glimpse of a human and doing so without licenses. Your queen has ordered you to patrol the surface to make sure that any merperson that is closer than 300 feet of the surface has completed the surface safety course. If fail at your task your civilization may be found.

Instructions: On the next screen you will be shown the law that the queen instructed you to enforce. The cards below the rule have information about four different merpeople that are swimming outside the city. Each card represents only one merperson. One side of the card tells whether or not they have passed the surface safety course and obtained a license. The other side of the card indicates the distance that they are from the ocean surface. Indicate only the card or cards you definitely need to turn over to see if any of the merpeople are breaking the law.

Rule: If you are within 300 ft of the surface, then you must have a license.

Total number of words: 518
Story 26:
The Temple of Hauhet is the greatest holy site in the Upper Nile, declaring her divine glory to all who pass through its monumental gates. You are its High Priest, most beloved of all Hauhet's children and endowed by Her with power over the sky, the land, and the mighty Nile river itself. However, this power does not come for free. Hauhet is a demanding goddess and holds you responsible for the security of her temple. To keep it sanctified, you perform a cleansing ritual on everyone who wishes to enter. Usually,

pilgrims don't mind waiting for the ritual to be completed; they honor Hauhet by respecting her wishes. However, theives and vandals do try to sneak inside unannounced, thinking they just just run off with Hauhet's many treasures. If any of those unclean brigands were to succeed, Hauhet would withdraw her blessing from this place, sink the surrounding villages beneath a great flood, and flay you alive!

Instructions: On the next screen you will be shown the rule that the goddess Hauhet requires you to enforce. The cards below the rule have information about four different people that are nearby the temple. Each card represents only one employee. One side of the card tells whether or not they have undergone the cleansing ritual and the other side of the card tells whether or not they go into the temple. Indicate only the card or cards you definitely need to turn over to see if any of the people are violating the sacred rules of the temple.

Rule: If you enter the temple, then you have undergone the cleansing ritual.

Total number of words: 513
Story 27:
You are a member of the Kesae tribe. Each spring the men of the tribe go to the edge of the desert on an elephant hunt. The cultural tradition requires women to stay at the village and prepare a “welcoming ceremony” for the men when they return. The elders select one man to stand guard and defend the women from a possible lion attack. He is given the title “Guardian.” Last year, a man from your tribe suspected that his wife conceived a child around the time of the welcoming ceremony that was not fathered by him and that the Guardian was the actual father of his wife’s child. \n\tBecause of these suspicions, the elders have asked you to stay near the village during the elephant hunt and spy on the activities of the married women. Your job is to make absolutely sure that no married women are ever alone with the Guardian. If you fail to enforce this rule the elders will hold you responsible and will banish you from the village.

Instructions: Below you will be shown the rule that you have been instructed to enforce. The cards beneath the rule have information about four different women at the village. Each card represents one woman. One side of the card tells whether or not they are married and the other side indicates whether or not they are alone with the Guardian. Indicate only the card or cards you definitely need to turn over to see if any of the women are breaking the law

Rule: If the woman is alone with the guardian, then she is not married.

Total number of words: 548
Story 28:
You are a spanner, an individual who can travel back and forth through time. Unfortunately, it is very risky to time travel too far into the past or into the future. Because of this, a group of spanners have gotten together and created a list of rules to try

to minimize the risk. You have been a spanner for quite a while and have a very good grasp of the rules and regulations. However, a lot of the novice spanners are really tempted to break the rules so that they can see what the year 3000 looks like, or meet famous historical figures. Recently, there have been a number of problems that the more experienced spanners have had to fix, at great personal cost. Therefore, they have asked you to enforce the rules of the group. This is a really big opportunity for you and if you do well, you could be given quite a few benefits. However, if you fail, your memories will be erased and your ability to travel through time taken away.

Instructions: On the next screen you will be shown the rule that you have been entrusted to enforce. The four cards on the next screen have information about four different spanners. Each card represents one spanner who has just come back from a span. One side of each card tells you how long they have been a spanner and the other side of each card tells you how far they traveled on their last trip through time. Indicate only the card or cards you definitely need to turn over to see if any of these spanners have violated the rules.

Rule: If you travel more than one year into the future, then you have been a spanner for more than one year.

Total number of words: 550
Story 29:
You are a member of a secret organization called the AISB. To join this group, all members need to undergo the Rite of the Burning Sands. This ritual is very painful and leaves a distinctive mark over the recipient's back. However, this shows that the recipient has enough strength and dedication to join. While it may be painful to get in, the group is very effective at caring for its members. Merely saying that you are a member, will often get you discounts and special treatment. You feel that it was entirely worth the pain to be part of the group. However, more and more often, you are hearing that there are people pretending to be part of the group. These people often cause a ruckus and are starting to give your group a very bad name. This is upsetting quite a few real members and they have asked you to stop them. If you succeed, they have promised to increase your status, but if you fail, they will kick you out of the group.

Instructions: On the next screen, you will be shown the rule that you have been asked to enforce. The cards on the next screen have information about four different people that you are currently investigating. Each card represents one of these people. One side of the card tells whether or not they are claiming to be a member of the AISB, and the other side of the card indicates whether or not they have undergone the Rite. Indicate only the card or cards you definitely need to turn over to see if any of these people are cheating the AISB.

Rule: If you are a member of the AISB, then you have undergone the Rite of the Burning Sands.

Total number of words: 548

Story 30:
You are a member of the Timkut, a desert people who value enlightenment above all else. Being a member of the Enlightened is a very prestigious position in your tribe. Before anyone is allowed to train for enlightenment, they have to voluntarily cut off one of their own fingers. This shows they have the strength and determination to devote their lives to the tribe. In exchange, the Enlightened are allowed to visit a sacred hut in your village. It is filled with delicious food and drink and valuables that the Enlightened may use. Unfortunately, there have been rumors that other members of the tribe are entering the hut, either out of curiosity or ill will. The leaders of the tribe have asked you to watch the hut to make sure that only the Enlightened go inside. If you succeed, they promise that they will let you train to become Enlightened which would greatly benefit both you and your family. If you fail, you will be disgraced, and you may even be expelled from the village.

Instructions: On the next screen, you will be shown the rule that you have been asked to enforce. The four cards on the next screen have information about four different people who are walking very close to the hut. Each card represents one person. One side of the card tells whether or not they try to enter the hut and the other side of the card indicates whether or not they are missing one of their fingers. Indicate only the card or cards you definitely need to turn over to see if any of these people are breaking the law.

Rule: If you enter the hut, then you are missing a finger.

Total number of words: 552
Story 31:
You are an enforcer for the Hyperspace Clergy. The Hyperspace Clergy is a group that governs all interstellar travel going through there area of space. To become a member of the Hyperspace Clergy you have to undergo a lot of tests to determine your loyalty to the government. However, the Clergy is very strict and failure is seen as disloyalty. Your job is to regulate who uses hyperspace while traveling. While hyperspace is much cheaper and faster than other methods of travel, too much use is destructive to the space-time continuum. Because of this, only diplomats, emergency vehicles, or individuals with clearance can use it. However, people try to sneak through and use hyperspace without clearance from the Clergy, because they think they wonÆt get caught. Your primary job is to catch these criminals. If you succeed, your family will be given the privilege of traveling through hyperspace (saving you a lot of money). However, if you fail, you will be considered disloyal, you will be fired, and you may even end up in jail.

Instructions: On the next screen, you will be shown the rule that you have been asked to enforce. In addition to the rule, there will be four cards on the next screen that have information about four different ships. Each card represents one ship. One side of the card tells whether or not the ship tries to enter hyperspace, and the other side of the card indicates whether or not the ship has clearance from the Clergy. Indicate only the card or cards you definitely need to turn over to see if any of these people are breaking the law.

Rule: In order to travel through hyperspace, you have clearance from the Clergy.

Total number of words: 560
Story 32:
Maruk the Great is the alpha male of a pride of African lions. As such, he has a sacred duty to protect the bloodline of his pride. Only the strongest and fastest of the males, himself included, must be allowed to mate with the lionesses. If weaker males, like that runt Lumar, were allowed to mate, they would pass on their feeble genes to the next generation (rather than his much stronger genes). To be given the priviledge of mating, the lions in the tribe have to prove their worth by defeating at least three other lions from competing prides. Since, life on the savanah is not easy, and Maruk's knows his pride must be the strongest if it, and his cubs, hope to survive. Recently Maruk has started to suspect that some of the weaker males try to mate with the females while you are the other lions are out patrolling. You decide to come back early from patrol to see what the other lions are up to.

Instructions: On the next screen, you will be shown the rule that everyone in the pride must follow. The four cards on the next screen have information about four lions that you come across when you come back from patrol early. Each card represents one lion. One side of the card tells whether or not the lion is trying to mate with a lionness, and the other side of the card tells whether or not they are one of the stronger members of the pride. Indicate only the card or cards you definitely need to turn over to see if any of these lions are breaking the rules of the tribe.

Rule: If they mate with a lionness, then they have defeated at least three other lions in battle.

Total number of words: 580
Story 33:
The Atlantean Brotherhood practices an ancient type of extraordinarily powerful magic. Passed down through the ages from the original inhabitants of Atlantis, it can only be wielded by those with Atlantean blood. Normal humans would be fried to a crisp just by watching one of your arcane rituals! Thus, you work in secret and admit into your ranks only those who are members of the bloodline. Luckily, a simple blood test can be used to determine if someone is descended from the Atlanteans or not. If they are, their blood will contain millions of tiny machines, called nanites, that were sent to Atlantis from the distant future. These nanites will show up as elevated levels of lead in the blood. Many scolars, journalists, and magicians of other traditions ask to witness your rituals, and all of them must submit to this blood test. Only after you have confirmed that their blood will withstand the power of your magic can they be allowed to witness one of your rituals. The last thing the Brotherhood needs is to have its name splashed all over the newspapers next to the words Gruesome and Murder!

Instructions: On the next screen, you will be shown the rule that you have been asked to enforce. The four cards on the next screen have information about four people who are in the temple. Each card represents one person. One side of the card tells whether or not they are going to watch the ritual, and the other side of the card tells whether or not they passed the blood test. Indicate only the card or cards you definitely need to turn over to see if any of these people are about to break the rules of the rituals.

Rule: If they watch the ritual, then they have passed the blood test.

Total number of words: 578
Story 34:
Man colonized Mars in the year 2517. Unfortunately, the settlers could not have known that the underground glaciers they used to irrigate the Martian surface contained billions of alien spores, just waiting to infest warm hosts! It only took a few weeks for the alien hive mind to spread across the Red Planet and take over half colonies. Now, mankind's only line of defense is a strict quarantine. No one from Mars is allowed to return to Earth without first spending an entire month in a quarantine station. No one has lasted more than a month with a spore infection, so if you're still alive at the end, you're clean. Unfortunately, it has been many years since the last outbreak and you are starting to worry that your guards are becoming lax, especially when someone offers them money. Should they screw up and allow anyone who is infected to slip through and get to Earth, the entire human race would be doomed! Needless to say, if this happened, you would most certainly lose your job a few weeks before you died a horribly gruesome death.

Instructions: On the next screen, you will be shown the rule that your guards are instructed to enforce. The four cards on the next screen have information about four different people on ships that are leaving the quarantine station. Each card represents one person. One side of the card tells how long they have been in quarantine, and the other side of the card tells whether or not they are traveling to Earth. Indicate only the card or cards you definitely need to turn over to see if any of these people are breaking the law and putting the Earth in danger.

Rule: If they travel to Earth, then they spent a month in quarantine.

Total number of words: 598
Story 35:
You are what they call a meat mechanic. You're a doctor who implants cybernetic devices into people's bodies. It's all the rage. You can boost people's strength, quicken their reflexes, give them artificial eyes, but the most popular cyber has always been the cosmetic stuff: smart tattoos, bio-luminescent hair, that kind of thing. You get paid the big bucks, too. The only problem is that you have to turn away lots of business. There have been cases where people with too much metal in the meat, as they say, have gone insane and killed dozens of people before they could be put down. Now, the law provides serious criminal penalties for doctors who allow their patients to have too much cyber

(the legal limit is four cybermods). The problem is that some of this stuff isn't too obvious. Once in a while, you get a guy who doesn't tell you about everything he's had implanted. If you implant someone that is over the legal limit for implants, you will be stripped of your license, fined, thrown in jail, and then probably mobbed by the guy's family (they are usually the ones that get attacked first).

Instructions: On the next screen, you will be shown the laws governing cyber implants. The four cards on the next screen have information about four different people who have entered your doctor's office. Each card represents one person. One side of the card tells whether or not they ask for an implant, and the other side of the card tells how many implants they had coming in. Indicate only the card or cards you definitely need to turn over to see if any of these people are trying to trick you into breaking the law.

Rule: If they request an implant, then they have less than 4 cybermods.

Total number of words: 553
Story 36:
You are a member of the Kesae, a hunter-gatherer culture living in the Ituri forest of central Africa. Each spring a group of young men from a neighboring tribe come to court the single women of your tribe. This is called the courting ritual. The ritual is conducted as such: When the courting men enter the village all of the single women form an immediate circle around them. This is called the courting circle. The married women stand outside of the courting circle behind their sibling or friend and provide counsel. However, during past courting rituals, some of the married women have been standing inside of the courting circle giving the impression that they are single. The elders of the tribe have given you the role of overseeing the ritual. Your job is to make absolutely sure that no married women are flirting with the men from another tribe. You feel honored to have this responsibility, but you know that if you do not uphold the customs you run the risk of being banished from your village

Instructions: On the next screen you will be shown the rule that the elders have instructed you to enforce. The cards below the rule have information about four different women that are attending the ritual. Each card represents only one person. One side of the card tells whether they are standing inside the courting circle or standing outside it. The other side of the card indicates whether they are married or are single. Indicate only the card or cards you definitely need to turn over to see if any of the women are breaking the rule of the courting ritual.

Rule: If you stand inside the courting circle, then you are not married.

G.2 Comprehension Stories

Familiar Condition

Total number of words: 548

Story 1:

You heard your coworkers rambling about the office space and it jarred you away from your work. You had been so involved with your duties that you failed to notice the time. It was already ten minutes past noon and you hadn't taken your lunch break! On any other day, it would not have been an issue, but today you had a meeting at one o'clock. As you hustled through the crowded downtown streets, you kept your eyes open for a good place to catch a quick bite to eat. You noticed a Subway across the street. Normally, you try to stay away from fast food restaurants, but you remembered a commercial that said some of their sandwiches had been approved by the American Heart Association. You got your food as quickly as possible, but it wasn't until you got back to the office that you noticed the fine print on your napkin: All the nutritional information was for plain, 6-inch subs without cheese or mayo. Your footlong sub with everything on it, on the other hand, was probably a coronary bypass waiting to happen! You checked your watch, but it was already too late to get back down to the store and back before your meeting. Instead, you had to toss your lunch in the trash and try to muffle the sound of your stomach growling all the way through the meeting!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What time was your meeting?

A: One
B: Eleven
C: Noon
D: Two

Question 2: In this story, where do you work?

A: Downtown
B: Uptown
C: Dinkytown
D: West Bank

Question 3: What is most important to the character in this story?

A: Making it to the meeting on time
B: Finishing their work before lunch
C: Being able to eat lunch
D: Not standing in lines

Question 4: Why didn't you finish your sandwich?

A: You didn't think the sandwich was healthy
B: You were late for your meeting
C: You found a bug in the sandwich
D: It tasted horrible

Total number of words: 596

Story 2:

You've been a smoker since junior high school. You took after your mother in this respect; she was a regular smoke stack. That is, she was until the lung cancer. Despite her cautionary example, and the fact that it's just way too expensive, you've been unable to quit. You've tried patches, gum, cold turkey, even a few 12-step programs, but nothing seems to work. Then, you moved to the frozen north. Nine moths out of every twelve, the world tries to kill you just for stepping outside. You can barely get from the office door to your car without sled dogs and rations! The worst part is that everyplace you go is a no-smoking area. Whenever the crave hits you, you've got to get bundled up, trudge out into the frigid cold, and nurse the tiny fire at the end of your cigarette through a few precious minutes of life. One day, you were sneaking a cigarette outside the office in what can only be described as The Blizzard of Doom. You had your back turned into the wind and were hunched over to protect your smoke. After about a minute of desperately puffing away, you noticed that your breath had condensed on the tip of your nose and turned into frost! Another minute, and you would have had an icicle on your face! You crushed your smoke into the permafrost, went back inside, and haven't craved a cigarette since. Now, when people ask if you smoke, you can tell them the truth!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: Which of your relatives died from lung cancer?

A: Mom
B: Dad
C: Brother
D: Sister

Question 2: Which of the following have you tried to quit smoking?

A: Patches
B: Cold Turkey
C: Punishment
D: Nothing

Question 3: Which of the following do you dislike about where you live?

A: It's very cold
B: A lot of places are non smoking
C: The people are rude
D: Cigarettes are expensive

Question 4: What led you to finally quit smoking?

A: You almost got an icicle on your face
B: You got horribly sunburned
C: Another relative died
D: It became illegal

Total number of words: 514

Story 3:

It's true: Santa Claus is getting old. He notices every year that his cheeks are getting a little less rosy and his bones have been starting to ache when he climbs down a chimney. This year, Santa decided to do something about it, so he called a board meeting with his top executive elves to brainstorm about the holiday plan of action. As Santa swayed back and forth in his big rocking chair, the elves began to hustle into the oval room. Santa could hear the sound of papers rustling and elves hurriedly typing away as they finished their Power Point presentations on gingerbread laptops. Then, the lights dimmed and the presentation began. Santa couldn't believe what he was hearing! The ideas all seemed to involve some kind of fake Santa taking over his duties: robot Santas, ninja Santas, even an army of atomic mutant Santas! What would the little children think if they woke up in the night and saw a mutant Santa stuffing their stockings? Old St. Nick just got up out of his chair and, without uttering a word, he walked out of the boardroom. Over the next six months, he joined a gym, got a personal trainer, and by the time December rolled around, he was stronger than any ninja imposter could ever be!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: Who was present at the board meeting?

A: Santa
B: The elves
C: The reindeer
D: Mrs. Claus

Question 2: What did Santa think about the proposed plans?

A: He didn't like them
B: He thought they weren't realistic

C: He thought they were great
D: He thought they were too similar

Question 3: How did Santa feel about his duties last year?
A: They were more difficult
B: They were easier than usual
C: They were the same as always
D: They didn't matter to him

Question 4: What did Santa do?
A: Left without saying anything
B: Got a personal training
C: Thanked the elves
D: Asked for better suggestions

Total number of words: 568
Story 4:
Every year, you look forward to chaperoning the prom. Watching the kids dance, talk and have a good time always takes you back to your high school prom. It reminds you that, the more things change, the more they stay the same. Each year, there's a new DJ or a new band, playing whatever the hip music is at the time. The dancing is always different, the dresses are always different (though the tuxedos rarely are), and the slang mutates at a rate that would put Influenza to shame. However, the popular kids always dominate the dance floor. The outcasts, when they attend, always come in some kind of costume designed to shock and apall. There's always that one girl or guy who stands by the punch bowl all night, tapping their feet and trying to look happy. There are always a few underclassmen who try to sneak in and end up standing by the wall while security calls their parents. Despite all of that, most of them still manage to have a great time. There are the pairs of promising, young lovers who gaze into each other's eyes as if their were no one else in the room. There are the serious dancers who finally get a chance to shine. There are always clusters of honest, stead-fast friends who camp out at a table and enjoy one of their last nights together. It's always the same music, only the lyrics change.

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: Why do you like chaperoning the prom?
A: Reminds you of your youth
B: You enjoy watching the kids
C: Nothing better to do
D: You get paid for it

Question 2: Which things change year by year?

A: The lingo
B: The band
C: The tuxedos
D: The types of people who come

Question 3: Who dominates the dance floor?

A: The popular kids
B: The jocks
C: Everyone
D: No one

Question 4: Who isn't allowed to come to the prom?

A: Underclassman
B: Seniors who won't graduate
C: Adults
D: People who didn't buy tickets

Total number of words: 608

Story 5:

The key to training an animal is continuous reinforcement. Every time your dog rolls over, you give him a treat. Even when it's just an accident. Any time you see that mutt rotate 360 degrees, you dig out a milk bone and make his day! There's just one problem: your roommate. Not only does she ignore the dog's rolling when you're not there, you've caught her giving the dog treats for no reason at all! Yeah, that might win her a canine friend, but it's really sabotaging your efforts. That little pooch is no slouch in the brains department and he should be making process a whole lot faster than he is! So, you told your roommate that, if the dog didn't learn to roll over for his treats by the end of the month, you were going to start leaving his milk bones in her shoes overnight! At first, she was indignant, and you supposed that's understandable. After the dog sent her first shoe to meet its maker, she got irate. After the second shoe bit the dust, she finally started to get with the program. You noticed a marked decline in your dog's annoying begging behavior within the first week! It was like flipping on a light switch. You knew he had it in him all along, you just had to give him an environment where he could be all he could be. Now, whenever the mutt gets a hankerin' for his treats, he starts cruising around on the floor like an out of control steamroller!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: How are you training your dog?

A: Continuous reinforcement
B: Treats
C: Punishment
D: Trainer

Question 2: Why were you angry at your roommate?

A: They would give the dog treats
B: They weren't helping train the dog
C: They were punishing the dog
D: They were training the dog

Question 3: What did you tell your roommate?

A: That you were going to put dog treats in her shoes
B: That you were going to train the dog to chew her shoes
C: That you were going to move out
D: That she would have to train the dog herself

Question 4: What does the dog do now?

A: Rolls over on command
B: Attacks your roommate's shoes on command
C: What they want when they want
D: Beg for treats

Total number of words: 538

Story 6:

No one gets into the Mafia because they have a great resume. New members are brought in by current members. You have to know people who know people, and know them long enough to earn their trust. The same is true for government defense contractors. Security access at your company is granted on a system of seniority. The theory is that, the longer you work here, the less likely you are to be a spy. Therefore, each level of access has a minumum years of service requirement. Unfortunately, this system is far from foolproof. You were recently promoted to a management position in the network security department when the previous manager didn't show up for work one too many times. Your first week on the job, someone hacked into the system and started copying sensitive files. You and your team managed to sever their connection before any real harm was done, but you're troubled by the incident. It looks like the hacker used a back door to get access to the system... a back door that someone with access would have had to put in place from the inside. Though the former manager had been with the company for almost twenty years, you consider him the most likely suspect. It just goes to show that seniority isn't always the best way to decide who's right for a job.

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: How do they determine who has access to sensitive files?

A: How many years they have worked there
B: Lie detector tests
C: Resumes
D: References

Question 2: Why were you recently promoted?

A: The previous manager stopped coming
B: You were due for a promotion
C: You applied for the position
D: You were friends with the boss.

Question 3: What happened during your first week?

A: A hacker broke in
B: You fired 2 people
C: You got fired
D: Nothing eventful

Question 4: Who is your main suspect?

A: The previous manager
B: Your current manager
C: A disgruntled intern who was recently laid off
D: Corporate competitors

Total number of words: 556

Story 7:

You take great pride in being the most successful, hand-made furniture business in the tri-state area. Okay, you're also the only hand-made furniture business in the tri-state area, but that should in no way diminish your success! You started this enterprise in your garage, making chairs and tables for friends. Now, you have a staff of carpenters and apprentices who do work for you. A few months ago, you noticed a disturbing trend: your cash box was filling up with refund receipts. It turns out that a shocking number of your customers had returned brand new furniture because of defects in construction. A few had even fallen apart with people sitting in them! You hired a friend of a friend to go undercover and see what your staff was doing wrong. Your spy reported back that, since they were getting paid by the hour, they were only motivated to do the bare minimum amount of work. Rather than flog the lazy toads, you decided to switch them to a sort of commission system where part of their pay is determined by satisfaction surveys. (You keep a list of customers and call them after a few weeks to see how they like their

furniture.) So far, it's been a great success. In fact, your staff is making a little more than they were on the old system because they've been producing such high-quality furniture!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: Why were people returning furniture?

A: Construction defects
B: The furniture fell apart
C: They weren't what the customer wanted
D: The salespeople were rude

Question 2: How did you find out about the problem your store was having?

A: You sent in a spy
B: You interviewed all the employees
C: You asked all the customers
D: You videotaped the workers

Question 3: How are you making sure the problem doesn't reoccur?

A: You give the customer's satisfaction surveys
B: You make the employees work on commission
C: You give bonuses to good employees
D: You fire employees who get bad reviews

Question 4: How did you start your business?

A: As a small business in your garage
B: As part of a small chain that you bought
C: With a group of like-minded friends
D: By working your way up to management

Total number of words: 548

Story 8:

The tire swing at Jesse Jackson Elementary is only big enough for one person to ride it at a time. Understandably, competition during recess can get pretty intense. (Wall Street stock traders could learn a thing or two from these kids!) You and the other teachers can tell the kids to take turns until you're blue in the face, but it never does any good. There's always one kid who refuses to get off, who just sits there and demands that someone give them a push. You've seen it a thousand times. More often than not, the other kids just get sick of it and walk away. An un-pushed tire swing is pretty much the height of boredom, so the problem kid eventually gets sick of it and leaves. Every once in a while, someone resorts to violence and you have to send everyone involved to the Principle's office. This year, however, something interesting happened. One of the kids came up with a rule that

you could only ride the tire swing if you'd already pushed someone else: one ride for one push. The idea spread through the school like a case of the flu (and let me tell ya, that's fast!), and now the kids enforce it on their own. It's like watching cave men discover fire (if by fire you mean the basic principles of economics, anyway).

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: Where do you work?

A: Elementary school
B: Preschool
C: Highschool
D: Private School

Question 2: What is the main problem the students have?

A: Sharing the equipment
B: Constant fighting
C: Tantrums
D: Bullies

Question 3: Who solved the problem?

A: One of the students
B: A group of teachers
C: The principle
D: The parents

Question 4: Which best describes the solution to the problem?

A: If you help pushed someone else then you can ride
B: If you push someone else then you are ignored for the rest of the break
C: If you don't share you don't get lunch
D: If you share you get first pick

Total number of words: 512

Story 9:

As an auditor for the IRS, it's your job to make sure that people who qualify for tax breaks are allowed to take them. It can be quite stressful because your superiors are constantly scrutinizing your work. During the last couple of days, you have been examining the forms of people who are applying for the Hope Learning tax credit. Applicants need to have taken at least one college course in the last year. This proves that they have been attempting to further their education. You notice that one of the applicants is a neighbor of yours. Unfortunately, you know that he never graduated from high school, and so could not have taken any college courses in the last year. His family

has fallen on hard times and you suspect that he is applying for the tax break to try and save some money. You'd love to just look the other way on this one, but if your supervisor caught the mistake, you could lose your job! If you report the fraud, your neighbor could go to jail! Your solution is to slip the application into your briefcase and alter your neighbors' tax forms to remove any mention of the Hope Learning tax credit. Oh, and maybe you'll shovel their walkway for them in the morning.

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What do you do for your job?

A: Make sure that people who apply for credits can take them
B: Check for people who may be cheating on their taxes
C: Supervise the other tax auditors
D: Issue refunds

Question 2: Whose application do you come across one day?

A: Your neighbors
B: Your sister in law
C: Your highschool sweetheart
D: A friend from college

Question 3: Which is the tax credit mentioned in the story?

A: Hope Learning tax credit
B: First-time Home owner credit
C: Lifetime Learner credit
D: Student loan interest repayment credit

Question 4: What are you planning on doing tonight?

A: Altering someone else's tax form
B: turning in your report to your manager
C: going out to eat
D: maybe quitting your job

Total number of words: 508

Story 10:

It's not a glamorous job, but working security at the local tennis club pays the bills. When you first started, the manager went on and on about how boring the place is and how the only way to stay awake is to drink coffee right out of the pitcher. That's why the events of your second day took you by surprise. The Club has this rule the loser of a match must buy the winner a drink afterwards. Apparently, some new guy didn't know about the rule and was refusing to buy his opponent a drink. They looked about to come to blows, so

you stepped in and tried to calm things down a little. The next thing you know, the winner takes a swing at you! Thank god for that Judo class you took in college, because your reflexes kicked in just in time to duck under the swing and throw the guy across the room. Unfortunately, there wasn't a whole lot of room in that direction and the guy ended up crashes through a plate glass window! The club manager yelled at you for a good hour over that one, and he made you pay for the window, but now all the regulars treat you like the king of the jungle!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: Where do you work?

A: A tennis club
B: A golf club
C: A fitness club
D: A skiing club

Question 2: What happened during your first week of work?

A: You got in a fight
B: You threw someone out a window
C: Someone threw you out a window
D: You fell asleep

Question 3: Which college class came in handy for you?

A: Judo
B: Karate
C: Communication
D: Negotiation

Question 4: The club manager asked you to..

A: Pay for the window
B: Apologize to the patron of the club
C: Resign
D: Stay awake

Total number of words: 528

Story 11:

You are a drug dealer, a good one. You make a lot of money and, so far, you've been able to keep your nose clean. Yesterday, however, the cops pulled you over for speeding. They spotted some drugs in the back of your car and arrested you. Now, they want to make a deal. They say they will let you off if you testify against one of your buddies who's going on trial for grand theft auto. You said yes just to get out of jail, but now

you're not sure you can go through with it. You can't help but worry about what your friends will think when they see you up on the witness stand, ratting out one of your own for the boys in blue. And then there's your reputation to consider. Being known as a narc isn't exactly great for business. In fact, your clients & suppliers will probably think you're a snitch! Unfortunately, it's a bit late to back out now. Instead, you call up your buddy's lawyer and let him know what the cops are up to. He tells you to go in and make a statement. Then, he'll cook up some excuse to have your testimony made inadmissable, which means you won't even have to take the stand! Everybody wins.

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: The dealer in the story was pulled over for…

A: speeding
B: a broken headlight
C: a broken brake light
D: failing to signal a turn

Question 2: The cops in the story offered the drug dealer a deal if he…

A: testified against a friend
B: quit dealing drugs
C: turned in his stash of drugs
D: spied on other drug dealers

Question 3: What is your friend being charged with?

A: Stealing a car
B: Posession
C: Assault
D: Battery

Question 4: Why don't you want to testify?

A: Your friends would be upset at you
B: Your reputation would be ruined
C: The cops would take back their deal
D: The other dealers would take revenge

Total number of words: 576

Story 12:

The Swiss Alps are some of the most beautiful mountains in the world. As a guard at the high-altitude Lonely Oaks Retreat, you feel privileged to work in such a pristine environment. The air is brisk, the snow is clean, and the mountain views beats any tropical shoreline you've ever seen! The cabins you work at are used as overnight shelters

for the many hikers who pass through the area. One day, you notice that a small group is being given the cold shoulder by some of the regular guests. When you ask why, the regulars tell you that the newcomers didn't carry their share of the firewood up the mountain with them. Since it gets so cold, and firewood is not available at this altitude, it is expected that each hiker who wants to stay overnight at the retreat will carry their own firewood up the trail with them. When the regulars tried to tell the newcomers about this rule, they just ignored them. Understandably, this ticked them off quite a bit and they've been giving the newbies the silent treatment ever since. You decide to play peacemaker and go over to introduce yourself to the new hikers. It turns out they're all from a school for the deaf and simply couldn't hear the other hikers yelling at them! Your regulars are suitably embarrased when you bring the newbies over to meet them and offer to buy a round of drinks to make amends.

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: Where do you work?

A: Cabins
B: Swiss Alps
C: Ski resort
D: Aspen

Question 2: Why is the group of regulars mad at the newcomers?

A: The newcomers didn't bring firewood
B: The newcomers were ignoring them
C: The newcomers were being rowdy
D: The newcomers tried to pick a fight

Question 3: Officially what is your job?

A: Security Guard
B: Manager
C: Mediator
D: Instructor

Question 4: Who are the newcomers?

A: A group of students from a school for the deaf
B: A group of students from a local skiing team
C: A group of students from a nearby highschool
D: A group of students from a nearby college

Total number of words: 560

Story 13:

As a Florida state patrolman, you have many duties. One of which is to make sure that freeway motorists obey the laws regarding the carpool lane. Like many other states, the Florida freeways devote the left lane to motorists who choose to carpool. These carpool lanes, often called High Occupancy Vehicle (HOV) lanes, are set aside in an attempt to encourage people to carpool more often. This helps reduce traffic congestion for everyone and, of course, it helps reduce air pollution from all those gas-hogging American automobiles. Emergency vehicles, like firetrucks and police cars, are also allowed to use the HOV lanes to bypass heavy traffic. As a Florida Highway Patrol officer, you are sometimes asked to drive an unmarked car and other drivers seem to think you're setting a bad example (or something). Every time you use the HOV lane in an unmarked car, you get a miniature parade of single-occupant cars following behind you. (If you could have gotten a bucket of ticker tape to toss out behind you, you would have!) It was a real pain in the neck, but your new partner had a brilliant solution. Every so often, she'll turn on her lights and just pull over to the side of the road. It scares the crap out of them! So far, not a single person has been dumb enough to drive past you without putting on their turn signals and merging right first!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: The story took place in which state?

A: Florida
B: Georgia
C: Alabama
D: Minnesota

Question 2: What kept happening when you were undercover?

A: Other drivers thought you set a bad example
B: Other drivers would follow you
C: Other cops would pull you over
D: Other drivers would make rude gestures at you

Question 3: How did you fix the problem that you were facing while undercover?

A: Put on your lights and pull to the side
B: Pull people over
C: Stop driving while undercover
D: Stop driving in the HOV lane while undercover

Question 4: Who came up with the solution to the problem?

A: Your partner
B: Your boss
C: Your spouse

D: You

Total number of words: 584

Story 14:

You work as a private security guard for TicketMaster, a corporation that sells concert tickets, and one of your main responsibilities is to control the crowd during ticket sales. Once in a while, you get a crowd of rowdies who just like to spit in the face of authority. Even when you're trying to enforce a rule that's in their best interest, like stopping people from cutting in line, they hassle you. This has actually led to riots in the past where customers and employees have been injured! This time, you and your partner have decided to take a more subtle approach: You play Good Cop, Bad Cop. He dresses up in full uniform and stands up front, looking mean. You get dressed up in your rattiest rock concert attire and wait in line with the rest of the rowdies. Whenever someone tries to cut, you apply some subtle social pressure, mostly in the form of voluminous foul language, and your partner doesn't even have to get involved! The whole experiment was a big success... until a week later when one of the concert fans spotted you working a different line. (This one was for a boy band, so you and your partner were both in uniform. No need to use psychology ploys on teenage girls.) All you heard was someone yell, Narc! before a trash can slammed into the side of your head! You had to get nine stiches and the bastard got away scot free! So much for undercover work.

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What is your job?

A: Private security guard
B: Police officer
C: Detective
D: Bouncer

Question 2: What problem(s) do you face on your job?

A: People hassle you
B: People cut in line
C: Your partner doesn't help you
D: The management doesn't treat you well

Question 3: How did you solve the problem in the story?

A: You went undercover while your partner stayed in uniform
B: You quit and went to work for a friend
C: You requested a new partner
D: You made sure that your weapons were more visible

Question 4: What happened after you implemented your plan?

A: You got hit in the head
B: Someone recognized you
C: You got into a fight with your partner
D: You got fired

Total number of words: 538

Story 15:

You've always thought of yourself as a kind of corporate ninja, traveling from one company to another to do jobs that no one else can (for a killer wage, of course). Recently, one of your clients has been getting complaints about managers promoting their friends and family ahead of more qualified employees. They've asked you to seek out the source of the nepotism, rectify these injustices, and take whatever action is needed to make sure it never happens again. It's quite a task, but you dive right into the data mining! While reviewing the regional production manager's file, you discover that friends of his have been promoted in every instance in which the hiring decision was his alone. In total, this accounts for over a dozen cases of documented nepotism. You can't just take back all those promotions; it would be embarrasing for everyone involved. Instead, you decide to reorganize his entire department and make it look like a cost-saving initiative! You update the requirements for every position and re-evaluate each employee, shuffling them around any way you wish until all the qualified people are in the jobs they deserve. In the end, the company benefits from having better people in key positions, a streamlined organizational structure, and Mr. Nepotism demoted to a position without hiring authority. You love it when a plan comes together!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What complaints has your client been getting?

A: Managers promoting friends
B: Managers demoting people they dislike
C: Managers think you are unprofessional
D: That they charge to much

Question 2: Who is causing the main problem for your clients?

A: The regional manager
B: The district manager
C: Middle tier managers
D: Section manager

Question 3: What is your solution to the problem?

A: To reorganize the department

B: To demote the manager(s)
C: To fire the manager(s)
D: To take back all of the promotions

Question 4: What happens to the company as the result of your plan?
A: They become more efficient
B: Not much
C: The workers are resentful
D: Your clients are resentful

Total number of words: 622
Story 16:
You like your job as a parking lot attendant because it's so low-stress. Cars come in, cars go out. People take a ticket, they give you money, they go home. A trained monkey could do it (though certainly not with the degree of grace and charm that you bring to the job!). At least, that's how it used to be. Lately, you've been catching a ton of flack from your boss about these mopeds that sneak in and park for free. Your lot is gigantic and (short of a chain-link fence and some razorwire) there's just no way to seal off the entire perimeter, so a lot of moped people just drive over the curb and park for free. People don't have to display their tickets to park in your lot, so there's no way to tell the paying customers from the freeloaders. That's how you see it, anyway. Your boss seems to think it's all your fault. Then, you had this brilliant idea. One day, you kept careful track of where all the paying moped folks parked. Then, you went around the lot, found all of the moped that snuck in, and popped their tires with an icepick! Someone must have complained because the cops came around and asked if you'd seen anyone suspicious in the area, but you just told 'em Yeah, a lot of 'em. All day long. They gave you a dirty look and went on their way. One thing's for certain: it's been a week since you saw a moped come into your lot without paying!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What is your job title?
A: Parking lot attendent
B: Security guard
C: Head of Parking and Transportation
D: Traffic patrolman

Question 2: What problem(s) do you face on your job?
A: Your manager yells at you about mopeds
B: People sneaking into the lot
C: People are very rude to you

D: You have too much work

Question 3: How did you solve your problem?

A: You popped some tires
B: You wrote people tickets
C: You decided to get a new job
D: You went above your boss's head

Question 4: How long has it been since you solved your problem?

A: A week
B: A few days
C: A couple of weeks
D: A month

Total number of words: 598

Story 17:

You're at the mall with a friend on the day after your birthday… which they completely forgot about. Normally, you don't even think about stuff like this, but you bought them a great present for their last birthday and you're feeling a bit short-changed. It comes up in conversation (quite by accident, I assure you!) and your friend's cheeks turn fire engine red. They apologize profusely and you tell them it's no big deal, all is forgiven. You don't give it a second thought and, you assumed, neither did they. Later on, you're walking through a department store and remember that you need to buy some new underwear. You naturally assumed that they wouldn't want to hang out in the underwear section, but they dove right in! While you're looking around, your friend picks something off the shelf and says, 'Here's your birthday present!' You honestly like what they've picked out, but you're more than a little confused. Why would they offer to buy you underwear?? Is this just an awkward attempt to make amends, or a not-so-subtle come-on? You never really thought of them that way, but stranger things have happened... You accept the gift, but then make a 'joke' about trying it on for them later. You don't laugh, you just stare. Their nervous laughter speaks volumes, so you decide to let them off the hook. After a playful, but hard, punch in the arm, you both proceed to the check-out lane.

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: Why are you upset at your friend?

A: They forgot your birthday
B: They blew you off last time you had plans
C: They owe you money
D: They were gossiping about you.

Question 2: What did you have to buy?

A: Underwear
B: Socks
C: Jeans
D: Shirts

Question 3: How does your friend try to fix the problem?

A: They offer to buy you the item you are looking for
B: They offer to pay you back the money
C: They offer to try on clothes for you
D: They offer to take you to dinner

Question 4: Why was your friend's offer awkward?

A: You were unsure of their intentions
B: You didn't think they were sincere
C: You didn't like the offer
D: You didn't think they would go through with it

Total number of words: 592

Story 18:

The horse racing institution has certain rules against drug use by jockies, and you take them very seriously. Most of these rules concern performance enhancing drugs, but they make no distinction between, say, steroids and 'recreational' drugs like marijuana. Recently, you stumbled across a jockie smoking pot out back. He told you that it's for medicinal purposes, but he's been keeping it a secret because he's afraid he'll lose his job if anyone finds out. You asked to see his prescription, but, of course, he didn't have it on him. You told him you'd let him off the hook for now, but that you'd better see that prescription soon or you'd turn him in. The problem is, now you think he might forge the paperwork. So, you 'suggested' to your superiors that a round of drug testing might be a good idea, but the guy's test came back negative. You have no idea how he did it, but it certainly makes him look guilty. You decide to test his 'medicinal' story by stealing his stash out of his locker and following him to see where he gets more. As it turns out, he's getting his 'prescriptions' filled by a guy who stands on the corner of 5th and Main! So, you take the pot you stole and turn it in to the commissioner, along with everything else you know about his habit. Rules are rules, and it serves him right for trying to pull a fast one on you!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What excuse did the jockie give you when you caught him?

A: That it is a prescription

B: That he has glaucoma
C: That he got special permission
D: That it wasn't what you thought it was.

Question 2: What did you suggest to your superiors?
A: That they do a surprise round of drug testing
B: That they do a surprise search of everyone's possessions
C: That they fire the jockie
D: That they give the jockie a performance review

Question 3: Why did you go to your superiors?
A: You didn't believe the jockie
B: You thought the jockie was breaking the rules
C: You thought the jockie blatantly lied to you
D: You thought the jockie may become violent

Question 4: What did you do after the superiors took your suggestion?
A: You stole something out of the jockie's locker
B: You followed the jockie
C: You confronted the jockie about his lie
D: You told some of the other jockies

Unfamiliar Condition

Total number of words: 570
Story 19:
The moon grows full as you wait for your son to return from his hunt. He's out there on the savanah with nothing but his spear to protect him. You are one of the Namka, a tribe of hunters and gatherers who live in southwest Africa. Every full moon you have a special feast where the warriors roast and eat a duiker (a small antelope). Last time you caught your son stealing some from the feast table! You know that it's your duty to turn him in, but your family would be disgraced. So, you made a deal with your son: If he can go into the jungle and 1) kill a new duiker to replace what he stole and 2) demonstrate his tracking skills by bringing back a rare ostrich eggshell before the next full moon, you'll let him tell the elders about his transgression himself. You hold out hope right up until the night of the feast, then you break down. You're about to tell the elders everything when a duiker carcass slams down upon the feasting table. Your son, covered from head to toe in dirt and blood, flashes you a fierce smile before taking his ostrich eggshell over to the tribal elders and asking for their forgivenes. They scowl, but can't help being impressed by the lad's courage. They invite him partake in the feast and forgive his trespasses, turning your night of despair into a joyous celebration!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: When does your tribe have the feast?

A: During the full moon
B: During the waxing moon
C: During the waning moon
D: During the new moon

Question 2: What did you catch your son doing at the last feast?

A: Sneaking duiker meat
B: Sneaking into someone else's tent
C: Stealing someone's ostrich egg
D: Threatening other boys

Question 3: What did you tell your son to do?

A: Kill a duiker
B: Find an ostrich shell
C: Apologize to the boys
D: To stay in the tent

Question 4: Why were you worried?

A: Your son hadn't returned
B: You were afraid your son had been killed
C: Your son had run away
D: Your son had failed

Total number of words: 558

Story 20:

On a remote island in Polynesia, there grows an aphrodesiac so powerful that no woman can resist a man who has eaten it. At least, that is the belief among your people, the Kaluame. Your council of elders has decreed that only married men may partake of this aphrodesiac, which you call cassava, because they disapprove of sex before marriage. However, the temptation of the cassava root is so great that a black market has sprung up on your island. Just the other day, you stumbled upon a make-shift camp where unmarried men were eating cassava, in preparation for a night of lust in the maidens' lodge. As a warrior of the tribe, you did your duty and arrested as many of the men as you could. However, when you brought them before the council of elders, you discovered that one of the lawbreakers was a nephew of one of the elders. The usual punishment for this crime is five days of labor, but the boy and his friends were let go with only a warning! When you tell the other married men about this, they fly into a rage, march upon the hall of elders, and burn it to the ground! Banished, the elders and their families

flee to the other side of the island. The other men asked you to take charge of the tribe, but after everything that happened, you're not so sure you want the job!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What role do you play in the tribe?
- A: Warrior
- B: Enforcer
- C: Council Member
- D: Tribe Leader

Question 2: Why is Cassava root so popular?
- A: It is considered to be an aphrodisiac
- B: It is considered to be very healing
- C: It is very rare
- D: It is very nutritious

Question 3: What is the usual punishment for sneaking cassava root?
- A: 5 days of hard labor
- B: 5 days banishment
- C: A month of hard labor
- D: A month of banishment

Question 4: Why did the men in the village get so angry?
- A: The elders let the other men off with a warning
- B: The elders violated the laws of the tribe
- C: The elders punishment was too severe
- D: The elders only punished some of the men

Total number of words: 560
Story 21:
You were once an elder of your tribe and ruled over an entire island in the South Pacific. Then, a group of bloodthirsty young men overthrew your council, burned down your hall of elders, and banished you into the wilderness. Now, you've been reduced to living in the jungle like a wild animal, hiding from predators and foraging for scraps! You've heard of a ruthless warlord named Big Kiku who will take in banished people if they swear an oath of loyalty to him. You're not sure if you can trust Big Kiku, so you decide to watch him from afar for a while. You get the impression that many of his underlings are unhappy with his leadership. The camp seems ripe for revolution, so you devise a desperate scheme: You harvest some Faraka leaves and grind them up into a slow-acting poison. Then, you sneak into Kiku's camp late at night and add the poison to his food.

The next day, you stride into the place with your spear held high and challenge Big Kiku's right to lead. When he accepts your challenge, you bide your time and wait for the giant to tire. Once you see that the poison is doing its work, all you have to do is push him over. The other men are more than willing to give you a chance as their leader, especially since you defeated a warlord so easily!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: At the beginning of the story, what was your main problem?

A: You had been banished from your tribe
B: You weren't able to find food
C: Your tribe was unhappy with your leadership
D: You had been poisoned

Question 2: What do you learn from watching Big Kiku?

A: That his tribe doesn't like him
B: That he just became leader
C: That he is not a very good warrior
D: That other tribes are scared of him

Question 3: What do you decide to do?

A: Challenge Big Kiku to a fight
B: Poison Big Kiku
C: Encourage the others to revolt
D: Ask if you can join the tribe

Question 4: How does your plan turn out?

A: You become part of the tribe
B: You defeat Big Kiku
C: The other tribe members dislike you
D: You have to leave to go to a different tribe

Total number of words: 586

Story 22:

One morning, four men from a neighboring tribe stagger into your camp. They say their village was attacked and now they, the only survivors, seek refuge with your tribe. You are escorting them to the hall of elders when an old man cries out from around a corner. It's Bo, a clumbsy old con artist who's always trying to sucker people out of their possessions. He's standing over a broken eggshell, crying about how that was his last one and his son needs it to carry water with him on a hunting expedition tomorrow. First of all, you seriously doubt that Bo doesn't have any more eggshells at home; he's well

known for stockpiling them. Second, you don't remember hearing anything break as you rounded the corner. Your guests, however, don't want to offend their hosts, so they generously offer Bo their eggshells, one for his son and one for himself. Later that day, you return to the scene of the crime and try to put the broken pieces together... they're not all there. You think Bo just brought one of his old, broken eggshells down here and pretended to break it in order to con your guests out of their valuables. So, you sneak into Bo's hut that night, steal some eggshells from his (not at all empty) stockpile, and give them to your guests as gifts from the tribe. They're impressed by your hospitality and Bo doesn't get to profit from his crimes!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: Why did the four men come to your tribe?

A: Their tribe was attacked
B: They wanted to join
C: They were looking for mates
D: They were looking to trade.

Question 2: Why don't you trust Bo?

A: You think he is lying
B: You didn't hear anything break
C: You think he is planning on harming one of the men
D: You think he may refuse to do his work

Question 3: What did you do that night?

A: Sneak into Bo's house
B: Confront Bo
C: Order Bo to return his gifts
D: Order Bo to leave

Question 4: Why is Bo upset?

A: He broke his eggshell
B: His son was leaving without the proper supplies
C: He had to work an extra shift when his wife needed him
D: He thought one of the men had stolen an eggshell from him

Total number of words: 574
Story 23:
Life is hard for the inhabitants of planet Zorton. With six legs and six feet it is quite a hassle to get dressed. First you put on the first sock, then you put on the first shoe. Next you put on the second sock and then the second shoe. Then, you put on the third... well,

you get the idea. Chezle, the king of Zorton, grew sick of this activity and offered a huge reward to anyone who could solve the problem. Applicants needed only to time their method for putting on six pieces of footwear and the fastest method would win. For six weeks, all anyone could talk about was their Big Idea for winning the contest. Some cut the time in half by putting things on a pair at a time, while others reduced the average time seven fold by only changing their socks once a week. The best time, however, was 0 minutes and 0 seconds. When the winner came to collect his prize, Chezle commented on how slim and form-fitted their shoes were. Why, he could even see each toe individually! It was then that he realized that his shoes were just tattoos; he wasn't actually wearing any shoes at all! Obviously, if the king had wanted to go barefoot all the time, he would have just done it on his own! So, he took back the reward money and had the tattoo-wearing, barefooted con artist executed at dawn. That'll teach him!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What was the contest for?

A: Putting on footwear
B: Putting on clothes
C: Making the king laugh
D: Pulling pratical jokes

Question 2: How long did the contest last?

A: 6 weeks
B: 5 weeks
C: 4 weeks
D: 3 weeks

Question 3: What happened to the contest winner?

A: He was executed
B: He got a prize
C: He was disqualified
D: Someone else claimed to win

Question 4: What did the king think of the winning submission?

A: He was furious
B: He felt cheated
C: He was thrilled
D: He was confused

Total number of words: 562
Story 24:

Growing up in a Peruvian village, you get to know the harvest rituals pretty well. The men pack up their burros with tools and supplies, then say goodbye to their families and head out to the fields. They don't return for weeks, but every day they send one of the burros back with bags full of food. All work and no play, they'd tell you when you asked about their trip, but you derive a wonderful sense of satisfaction from watching that burro head down the mountain, loaded down with fresh vegetables. That's why you were so upset when one of the burros wandered back to camp with some of its food missing. These burros are trained to walk themselves back to the village, but not to come back. You followed the next burro from a discreet distance and saw it wander off the trail. You raced to catch up and found that tiny bits of sweet meat had been left on the trail... and led right to a neighboring village! The next day, you chased down a pair of badgers, stuffed them in a sack, got them good and angry, then packed them up on one of the burros. Will those thieving bastards ever be surprised when they unpack that bag! Meanwhile, you escorted the real food back to the village in person and recieved a hero's welcome; it was the first food your village had seen in days!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: How long does the harvesting trip last?

A: Weeks
B: Hours
C: Days
D: Months

Question 2: What happened during the harvest that was unusal?

A: One of the burros came back
B: Some of the families came with
C: Some of the men disappeared
D: One of the men refused to work

Question 3: What happened when you got back to the village?

A: The villagers were thrilled to see you
B: The villagers were angry that you came back early
C: The villagers were confused that you came back by yourself
D: The villagers were worried about the other men

Question 4: Why were you mad at the neighboring village?

A: They stole your food
B: They raided your village
C: They sent you angry badgers
D: They poisoned your harvesting fields

Total number of words: 568
Story 25:
Jane is a mermaid. Life in the deep Atlantic is pretty easy: the weather's always the same, coral hut to live in, and there's free shellfish 24 hours a day! There was just one rule Jane had to obey: stay away from the surface. The creatures that inhabit the world above are killing machines that will gleefully harpoon anything that crosses their path. However, Jane used to play around in a sunken ship when she was little, and she couldn't imagine how such demons could have created the things of beauty she found there. She knew that, if she could just get to the surface, she could prove that the humans were not demons. The problem was that it was a long trek up to the surface and, if anyone realized she was gone, they would come after her. Then, she thought of a great idea: She would drag the wooden mermaid from the sunken ship up to the top of the coral reef and make it look like she was up there catching some rays! It worked like a charm, too. When the other mermaids finally discovered the deception, search parties were sent out in every direction, but no sign of Jane was ever found. They turned the statue into a memorial and now, whenever mermaids and mermen tell their merchildren not to swim near the surface, they always end with 'or you'll end up harpooned and eaten, like poor aunt Jane!'

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What was Jane not allowed to do?
A: Go near the surface
B: Play in the sunken ships
C: Eat the shellfish
D: Go near the coral huts

Question 2: Why did Jane not follow the rule?
A: She didn't believe the stories
B: She knew she could prove them wrong
C: She didn't care what her parents said
D: She thought it was too much work

Question 3: How did Jane sneak away?
A: She made it look like she was at the coral reefs
B: She made it look like she was asleep in her room
C: She said she was going to play with a friend
D: She snuck out the back door

Question 4: If the towns' peole were right, what probably happened to Jane?
A: She was harpooned
B: She was eaten

C: She got trapped and starved
D: She got lost

Total number of words: 562
Story 26:
The Temple of Hauhet is the greatest holy site in the Upper Nile. It's towering statues and gold-plated walls glitter in the sun, declaring Her divine glory to all who pass by its monolithic gates. You are its High Priest, most beloved of all Hauhet's children and endowed by Her with power over the sky, the land, and the mighty Nile river itself. However, this power does not come for free. Hauhet is a demanding goddess who takes the purity of her temple quite seriously. To keep it sanctified, you perform a cleansing ritual on everyone who wishes to enter. Usually, the pilgrims don't mind waiting for you to come out and complete the rather lengthy ritual; they honor Hauhet by respecting her desire to protect her Earthly residence. A few years ago, a pair of theives managed to climb over the wall late at night and snuck off with some of Hauhet's treasures. She commanded you to punish the people of the Nile by summoning a great flood that destroyed their homes and washed away their crops, dooming them to suffer through the rest of the year with neither food nor shelter. The thieves were never caught, but it's a pretty good bet that they were among the casualities. Now, the villagers send a dozen warriors to stand guard around the temple at all times, and no one has dared to trespass in her divine presense since!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What is your job?
A: High Priest
B: Security Guard
C: Policeman
D: Theif

Question 2: Where do you work?
A: Temple
B: Nile
C: Market
D: South Africa

Question 3: What happened a few years ago?
A: Some thieves snuck in
B: Treasure got stolen
C: There was a great flood
D: The temple burned down

Question 4: What is required for anyone to enter?

A: Cleansing ritual
B: Gift of gold
C: Cover charge
D: Interview

Total number of words: 592

Story 27:

Hunting elephants is not easy. It takes years of training, weeks of preparation, and many days spent out on in the brush, tracking and trapping your prey. Thus, the women of the Kesae tribe have a lot of time to themselves. With nothing to do on those long, cold nights, the women must always look for new ways to occupy themselves. That's why there was such a commotion when three strange men wandered into their village. Each was covered in sunburns and nearly delerious with hunger, so they took them in without a second thought! They cleaned and fed them, and made sure there was always someone in their tents to tend to their every need. In fact, they did such a great job that the men healed in just a few days and were able to continue their journey the day before the Kesae hunters returned with their kill. During the week that followed, a strange thing began to happen. One by one, the young women began to confess to their husbands and fathers that they had been seduced by the strangers. The final tally was that two out of every three women in the village had engaged in relations of one kind or another with at least one of the strangers! The Kesae men were understandably enraged. They sent their best trackers into the bush to hunt down the interlopers, but no sign of them was ever found. They were never seen in the village again... or, if they were, the women certainly never mentioned it.

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: Which of the following is true about the Kesae tribe?

A: The tribe hunt elephants
B: The women are usually alone
C: All members of the tribe are responsible for finding their own food
D: They often hunt alone

Question 2: What was wrong with the men that wandered into the village?

A: They were sunburned
B: They were starving
C: They were looking for a tribe to join
D: They were looking for missing people from their tribe

Question 3: How long did the visitors who came to the village stay?

A: A few days
B: A few minutes
C: A few hours
D: A few weeks

Question 4: What happened after the other members of the tribe returned?

A: They found out that many of the woman had been unfaithful
B: They went back out to find the men
C: They went back out to hunt again
D: They found the missing members of the tribe

Total number of words: 606

Story 28:

Traveling through time ain't like dustin' crops! Even the tiniest mistake can have horrible ramifications for the space-time continuum. Therefore, the spanners (as they call themselves) have formed an organization to protect the timeline. They have a rule: new spanners are not allowed to travel more than one year into the past or future until they've gone an entire year without, how shall we say... screwing anything up. However, it can be quite difficult to resist the temptation for your whole first year. Imagine it: You've just been given the power to travel through time... and then told not to use it, at least not too much. Want to see what the year 3000 is like? Too bad, you have to wait a year. The problem is, it's hard to stop them. There's no way to watch them all the time, so to speak. This has resulted in a few major screw-ups that the rest of the organization barely managed to fix. Benjamin Franklin (that's right, he was a time traveler, too!) devised an ingenious solution. He organized a group of spanners, stationed in the distant future, who research everything every spanner has ever done. From their point of view, everything the rest of us will ever do is 'the past'. They look for times and places where spanners are doing things they aren't supposed to be doing and send a veteran spanner instructions on how to stop them. Now, there's no way to break the rules, because the organization already knows how they stopped you!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What's the main rule new spanners have to follow?

A: Don't travel more than a year into the past
B: Don't travel more than a year into the future
C: Don't travel by yourself
D: Don't travel without telling someone

Question 2: Who came up with the plan to stop people who broke the rule?

A: Ben Franklin
B: A group of veteran spanners
C: Confucious
D: A group of spanners from the future

Question 3: Why does the plan work so well?

A: Because they know what you are going to do before you do it
B: Because the punishment is so severe
C: Because everyone works extremely hard to keep it going
D: Because they changed the rule

Question 4: Who is in charge of enforcing the rule?

A: Veteran spanners
B: Everyone
C: The council
D: You and your friends

Total number of words: 544

Story 29:

You know all of those stories about secret societies that control everything? They're all true. You know because you're a member of one: The AISB. Getting into such an exclusive and powerful group isn't easy! You have to prove your loyalty in a number of gruelling tests, and then endure the Rite of the Burning Sands, a torturous ritual that leaves a distinctive scar across your back. But, man, is it worth it! As one of the illuminati, you enjoy wealth and power beyond most people's wildest dreams. However, you still have to work to protect it. Reporters and investigators can all be discredited easily enough, but a few actually try to impersonate you. They scar up their backs and try to use your name to get whatever they want. Rather than step up security, you discourage these imposters by inviting them to join the group. You put them through the trials and subject them to the Rite of the Burning Sands, but then you make sure to scar their backs in a different way, marking them forever as a traitor to the group! They can never again fool anyone into believing they are one of the Illuminati and the real secret masters will make the remainder of their lives an example to others. So far, it only takes one example every decade or so to keep the rest in line!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What does your group use the Rite of Burning Sands for?

A: To leave a scar on a person's back
B: To brand someone as a member

C: To brand someone as a traitor
D: To leave a scar on a person's chest

Question 2: What are some of the problems your group faces?
A: Imposters
B: Reporters
C: Theives
D: Other secret groups

Question 3: What methods does the AISB use to fix their problems?
A: Invite them to join
B: Brand them as traitors
C: Discredit them
D: Kill them

Question 4: How often do you have to 'make an example' out of someone to stop your main problem?
A: Once a decade
B: Once a year
C: Once a month
D: Once (no one's ever done it again)

Total number of words: 576
Story 30:
Life is pain. We are born, we toil, we die, and then we are reborn to toil and die all over again. The only way to escape this cycle is to transcend material reality and enter a higher plane of existence. That is why your people, the Timkut, have always valued enlightenment above all else. Anyone who is willing to devote their life to the pursuit of enlightenment is allowed to live in quiet comtemplation. The rest of the tribe supports them with gifts of food and clothing, defends them against thieves, and maintains the small monastery in which they live. However, times have grown tough for the Timkut. Drought and pestilence have depleted your stores of food, spreading famine among the people. Some of the young men have grown resentful of the easy life of the monks. They claim that most of them aren't really in pursuit of enlightenment, they're just pretending in order to get all the free stuff. A few times, you've had to put down riots before they could reach the monastery and kick the monks out... or worse. As a compromise, you devised a drastic plan to prove the monks' devotion to enlightenment: every monk must voluntarily cut off one of their own fingers before being admitted into the monastery! Sure enough, almost half refused to do it. They were banished from the tribe and chased out into the wilderness. The rest formed the Order of Nine, for what should be obvious reasons.

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What does your tribe value?

A: Enlightenment
B: Power
C: The cycle of life
D: Solitude

Question 2: Why are the tribes' people mad at the monks?

A: They believe some of the monks are pretending to be enlightened
B: The tribes people have very little food
C: The tribes people are resentful of the monks
D: They believe the monks are planning a rebellion

Question 3: What was each monk asked to do?

A: Cut off a finger
B: To leave
C: To fight for the tribe
D: To hunt for the tribe

Question 4: What happened to the monks who refused?

A: They were banished
B: They were killed
C: They were praised
D: They were forced to do hard labor

Total number of words: 592

Story 31:

As a member of the Hyperspace Clergy, it is your sacred duty to track down and punish those who use hyperspace travel without the Clergy's permission. The reason is simple: punching a hole into hyperspace damages the entire space-time continuum. If used too often, the technology can destroy entire solar systems! This is not a responsibilty the general public is equipped to handle, but there are always a few who think they know better. Unfortunately, advances in science have made it possible for hyperdrives to be installed on individual ships, so anyone can punch their way through space-time from any location, at any time! This caused an epidemic outbreak of disobedience that not even you and your fellow Clergymen could stop. Eventually, you had to make a hard decision... stop enforcing the law on a single, high-traffic system and let nature take its course. It only took a few months before gravitational anomalies to start to occur. You made many announcement explaining the effects and urging the inhabitants to either stop using unregulated hyperdrives or abandon their homes immediately. Fortunately, enough

of them heeded your call so that only a few thousand died when their sun went nova, incinerating the inner planets. Now, the public enforces the law for you. No one wants to suffer such a gruesome fate, so they mob anyone who enters the system illegally, or at least rat them out to the Clergy. It was a terrible sacrifice, but it has undoubtedly saved the lives of countless billions throughout the galaxy.

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: Why is it bad to use the hyperspace technology too much?

A: It can damage the space time continuum
B: It can destroy solar systems
C: It can destroy vehicles
D: It can destroy economies

Question 2: What hard decision did you and your coworkers make?

A: To not enforce the law
B: To punish everyone even more severely if caught
C: To break the law
D: To tell the law when your other coworkers broke the law

Question 3: What happened after your decision?

A: Thousands died
B: A sun went nova
C: Everyone stopped breaking the law
D: No one listened

Question 4: How is the law enforced now?

A: By the public
B: By an elite group of soldiers
C: By the clergy themselves
D: By no one

Total number of words: 590

Story 32:

Usually, a lion's reign as alpha male of his pride ends in violence. Eventually, even the strongest of males grows old and weak and, sooner or later, a younger male is able to take him down. This results in a smooth transition of power, since the younger male has proven himself the strongest member of the pride. The reign of Maruk the Great, however, was ended by a stampeding herd of hippos. This left the rest of the males in an awkward position; they would all have to fight each other to prove which was the strongest. For three days and nights, they waged savage battle on one another. Only a few

survived the ordeal. One of them, ironically, was a weak male named Lumar. It seems he had been hiding in the scrub the whole time, only venturing near the rest of the pride at night, to scavenge bits of food. By the time the other males had finished killing and crippling each other, Lumar was no longer the weakest member of the pride. The bar, as it were, had been set much lower than before. Lumar grew braver and braver with each passing day, until the strongest of the remaining males managed to corner him. With one lame leg and numerous broken bones, he was no match for even and Lumar's puny jaws. Thus did the weakling become Lumar the Runt King, whose reign lasted only as long as it took his own cubs to overthrow him. You just can't beat natural selection.

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What happened to Maruk?

A: He got killed by hippos
B: He was forced to be leader of the tribe
C: He died while fighting the other males to be leader of the tribe
D: He was forced to choose who would be the next leader

Question 2: How long did the battle last?

A: A few days
B: A few hours
C: A few weeks
D: A few months

Question 3: Who was Lumar?

A: The sole survivor of the fight
B: The one who hid during the fight
C: The strongest male in the pride
D: The old leader

Question 4: How long did Lumar last?

A: Until one of his cubs killed him
B: Until he was killed by hippos
C: He was one of the first to die in the fight
D: He was the last to die in the fight

Total number of words: 564
Story 33:
The Atlantean Brotherhood is a secret society that claims to know the secrets of magic that were unlocked by the original inhabitants of the Lost City. You'd love to write a book about them, but they claim that the powerful magic unlocked by their rituals would

kill any normal human who witnessed them. They only admit descendents of Atlantis to their organization; they administer a blood test to screen their initiates. You managed to find out that what they look for is a higher than normal level of lead in the bloodstream (they think this indicates the presence of nanites, tiny machines that came to Atlantis from the distant future). You asked a friend who works at the blood bank to get you a sample that would pass the test, then you switched it for your own after the Atlanteans drew your blood. Sure enough, they let you attend one of their rituals as an observer, satisfied that you could withstand the tremendous strain of being exposed to magic. You have to admit, as their wierd ritual started to pick up, you got a little worried. What if something really did happen and your face melted off like in Raiders of the Lost Ark? Despite a little shortness of breath and rapid heartbeat, you made it through just fine. Your expose of the cult even made the best seller list! Of course, now you hear that the Brotherhood has placed a curse on you...

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What is your job?

A: Reporter
B: Security guard
C: Magician
D: Seer

Question 2: How do the Atlanteans screen initiates?

A: Blood test
B: Interview
C: Ritual
D: Spells

Question 3: How did you get into the ritual?

A: You passed the screening process
B: You switched your blood with someone else's
C: You injected yourself with nanites
D: You bribed one of the guards

Question 4: What happened during the ritual?

A: Nothing
B: You needed to be rushed out as you started to melt
C: You were discovered as an imposter
D: You died

Total number of words: 520

Story 34:
Man finally colonized Mars in the year 2517. When the first settlement became self-sufficient, all of mankind joined together in celebration. However, humanity was not the first species to have accomplished this feat. An alien race had seeded it with hybernating spores millions of years before. Countless billions of the parasites laid frozen in vast, underground glaciers, just waiting to infect warm bodies and use them as incubators. When the original colonists terraformed the planet, they used these glaciers to return water to the Martian surface... and the spores came with it. Scientists only discovered the epidemic when a deadly epidemic swept across the red planet, killing hundreds and infecting thousands more. However, what they found was no simple disease. The alien spores didn't just spread from host to host a normal virus. They also absorbed their victims' knowledge and memories as they infested and consumed their brains. Then, when they finally killed their host and escaped into the air, they transmited this stolen knowledge to every other spore they encountered. Within weeks, half of the Mars colonies were under the control of a vast, alien hive mind that mankind could not wage war against! Now, only a strict quarantine keeps humanity alive. If anyone infected with the spores were allowed to return to Earth, the human race would be doomed!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What year did humans colonize mars?
- A: 2500's
- B: 3500's
- C: 2300's
- D: 3300's

Question 2: Where were the spores hiding?
- A: Underground
- B: In glaciers
- C: In the air
- D: In volcanic dust

Question 3: What did the spores do?
- A: Kill their hosts
- B: Steal the memories of their hosts
- C: Drive their hosts insane
- D: Control their hosts

Question 4: What happened in the end?

A: A giant hive mind took over some of the colonies
B: Mars was quarantined
C: The giant hive mind was destroyed
D: Humanity lost and was eliminated

Total number of words: 606

Story 35:

It has often been said that Man and Machine were not meant to mix. Maybe that's why people who get too many cybernetic implants eventually go insane and kill everyone they can get their robotic hands on. Or maybe the electrical fields created by all those implants interfere with the nervous system and cause some kind of psychological break-down. Whatever the reason, these fits of lunatic rage are called Cykosis, and your little brother was the first recognized case. He was an athlete, back before there were laws on how many implants you could have. It started with a simple muscle-boost, then he got his reflexes wired. After that, it was cyber-eyes and a wireless neuro-jack. Then he got his muscle-boost upgraded and bio-luminescent hair grafted onto his scalp. Ironically, it was the wig that did him in. You were all sitting at the dinner table, watching his hair change color like a mood ring, when he jumped up out of his seat smashed the table right in half! Your sisters were flying across the room before you even had time to blink, then he was tearing into Dad like a rabid hyena! You still don't remember how you got to the gun rack, but you managed to load two cartridges into the shotgun before he noticed what you were doing. It took both barrels to stop him from snapping your neck. It was the most terrifying thirty seconds of your life. And that, my friends, is why you can't have too much metal in the meat.

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: Who was the first recognized case of Cykosis?

A: Your brother
B: You
C: Your best friend
D: Your father

Question 2: What does Cykosis do?

A: Drive the person insane
B: Push the person into a homicidal rage
C: Takes over the nervous system
D: Push the person into a coma

Question 3: Which of the following is/are possible explanation(s) for Cykosis?

A: Too many electrical fields
B: The implants are defective
C: Leakage of the metal into the flesh
D: Neural connections get cut during implantation

Question 4: During the fight at dinner, who got hurt?

A: Your sisters
B: Your brother
C: Your friends
D: You

Total number of words: 564

Story 36:

Tumbo's hands are sweating. His heart pounds in his chest like the stampeding hooves of a thousand elephants! The dance is about to begin. Every year, the people of the Kusai tribe invite men from all over Africa to compete for a chance to court their beautiful women. The competition involves a simple dance of just a few steps, but it has been known to go on for days! The last men left standing are honored with a great feast and the company of many beautiful, young maidens. Tumbo feels his feet begin to move with the rythmn of the drums. Soon, a crowd of hundreds is dancing around the drum stage, leaping and weaving in time to the music! Suddenly, Tumbo's feet are no longer beneath him... he stumbles and hits his head on the hard-packed earth. He rises and tries to dive back into the dance, but again the ground rushes up to meet him. It takes three Kusai warriors to drag him out without getting trampled, for none of the other men are willing to quit the dance just as it begins. They take Tumbo to the medicine woman's lodge; she bandages his ankle and sends him on his way. Now, Tumbo's heart pounds once more inside his chest, for it should be many hours before another man is forced to leave the dance. Tumbo shall spend them recuperating with the young women of the Kusai tribe!

Instructions: On the following screens you will be presented with the comprehension questions specific to the story you just read. Each question will be followed by four choices. Please select the best answer or answers to the question.

Question 1: What tribe does Tumbo belong to?

A: Don't know
B: Kusai
C: Kaluame
D: Timkut

Question 2: Why is Tumbo so nervous?

A: He is about to participate in a dance ritual
B: He is about to compete for women

C: He is about to fight one of the other warriors
D: He is about to undergo a rite of passage

Question 3: What happens to Tumbo?
A: He makes a mistake almost immediately
B: He has to go to the medicine lodge
C: He impresses the other men
D: He impresses the other women

Question 4: What does Tumbo do afterwards?
A: Spend time with women of the tribe
B: Restart the ritual
C: Stay in the medicine lodge
D: Think of ways to regain his reputation