REASONING AND RECALL IN SCIENTIFIC AND RELIGIOUS CONTEXTS

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This paper focused on differences between science and religion based on McCauley's (2000) proposal that science and religion are cognitively different. The cognitive distinction between science and religion proposed by McCauley parallels a distinction within the dual-process theories of reasoning literature between two information processing systems, Analytic and Intuitive. The present studies explored differences between types of context (religion or science) on processing and recall. Specifically, reasoning and recall were investigated within a science or religion context, hypothesizing that science context would elicit Analytic processing whereas religion context would elicit Intuitive processing. Since individual characteristics were hypothesized to influence type of processing independently of context, they were assessed using a demographic questionnaire, the Religious Orientation Scale-Revised (Gorsuch & McPherson, 1989) and a newly constructed Scientific Attitude Assessment scale. The scales were found to be orthogonal in both studies, and to be parallel to dimensions of individual characteristics, indicating they were appropriate measures for classifying individuals. The results of the recall tasks in Study 1 did not support the hypothesis that context elicits one type of processing over the other. Therefore, a more cognitively demanding reasoning task was used in Study 2 to investigate the same hypotheses. Results of Study 2 supported the hypothesis that context elicits one type of processing over the other. However, the effect of context was in the opposite direction as hypothesized with religion context eliciting more Analytic processing and science context eliciting more Intuitive processing. Several possible reasons for the reversed trend in the
results are discussed including story construction, participants' dependence on expert knowledge, and measures of individual differences. Directions for future work are suggested.
I would like to dedicate this manuscript to my unconditionally supportive husband, Frank. Without his love, support, and encouragement this process would not have been as enjoyable.
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INTRODUCTION

The desire to explain the world comes naturally to everyone, whether they look at the world through the science window or the religion window. The crucial difference is that science brings to the window a sophisticated system of generating and evaluating evidence that relies on cultural arrangements. Because the sophisticated system of science requires teaching and skills that do not come naturally to humans, it is rare compared to religion. Religion is more common and has recurred more often throughout history because of its reliance on explanations that are familiar, uncomplicated, and utilize cognitive mechanisms that arose early in human development. The validity of these differences can be tested by investigating differences in individual’s thinking across domains to see how these ways of thinking are used to explain the world.

McCauley (2000), in a much discussed article, proposed that religion is cognitively natural and science is cognitively unnatural. By “natural”, McCauley meant intuitive, familiar, obvious, self-evident, and not requiring reflection. For McCauley, while cultural institutions are important to both science and religion, they play a more integral role in the generation and persistence of science than in religion. For example, science has never emerged in a non-literate culture. The skills utilized in science must be taught because they do not come to humans readily. Consequently, the cognitive activity underlying religion relies far less on particular cultural input than does the cognitive activity of science. Thus, science depends on cultural arrangements such as journals and professional associations that entail difficult learned forms of cognition. The progress of science depends on the development and possession of specialized intellectual skills and the comprehension and retention of scientific materials, whereas religion does not require the development or possession of these types of specialized skills in order to be
comprehended or retained. Although both religion and science are concerned with providing explanatory theories, religion relies more on basic cognitive capacities, one of the most important being the ability to distinguish agents and their actions from other things in the world. Science however, moves away from such agency detection and turns to other methods in order to understand nature for its own sake.

Before moving on, a clarification needs to be made as to what is meant by “religion”. In this work, religion refers to what is sometimes termed “folk” religion or an individual’s intuitive, natural God concepts that are used in everyday life. This is different from what is sometimes termed “doctrinal/institutional” religion, which refers to formal theological teachings of a church. There is a tendency for “folk” religion concepts to move away from “doctrinal” religious teachings which has been termed “theological incorrectness” (Slone, 2004). For example, the theological teaching “God is a formless being that exists everywhere at once” becomes “God is the big guy in the sky”. Barrett & Kiel (1996) showed that the tendency to rely on “folk” religion explanations for events was strong enough to persist even when doctrinal teachings were made more salient. Hence, “folk” religion was of interest here since it is universal and relied on in everyday contexts more than “doctrinal” religion.

The “folk” and “doctrinal” religion distinction is also similar to a theory proposed by Whitehouse (2004) that explains two divergent modes of religiosity that are termed doctrinal and imagistic each of which activate different types of memory. The doctrinal mode of religiosity entails frequent ritual actions that are routinized and thus activate semantic memory enhancing the potential of authoritative teachings to be stored in memory. The imagistic mode of religiosity entails practices that are low in frequency and highly arousing thus activating episodic memory and triggering spontaneous exegetical reflection. The spontaneous exegetical reflection leads to
a diversity of religious representations similar to the “folk” religion and “theological
incorrectness” described above. Whitehouse’s theory of modes of religiosity is another way to
explain the difference between “folk” and “doctrinal” religion and the memory differences
associated with them. The imagistic mode is associated with “folk” religion whereas the
doctrinal mode is associated with “doctrinal/institutional” religion. Each mode activates a
different memory system, leading to the possibility of differential recall of events and
information depending on the mode the information is experienced through. The imagistic or
folk religion is based on episodic memory because it is more experiential due to the low
frequency and high arousal of practices. The doctrinal or institutional religion is based on
semantic memory because it entails frequently repeated ritualized actions that are designed to
reinforce teachings.

Science also has a formal and “folk” distinction as religion does. Formal science is what
does not come naturally to human thought and must be taught. For example, educated
hypothesis testing, looking at the control factors of a study, carefully scrutinizing results, and
evaluating conclusions based on the quality of experimental conditions are skills necessary for
formal science that must be taught. “Folk” or intuitive science is based on the natural human
tendency to figure out the physical world. Everyone from a very young age develops ideas about
how the world works including how things are supposed to move, what things are made of, and
how living things think. These ideas are known as intuitive physics, intuitive biology, and
intuitive psychology, respectively (Baillargeon, 1993; Carey, 1995; Gelman & Wellman, 1991).
McCaugley referred to formal science and claimed it is unnatural because of its reliance on
cultural arrangements of teaching its sophisticated system.
The main focus of this study was on the differences between folk religion and formal science. Cognitive differences may not be expected between folk religion and folk science to the extent that both are argued to come naturally to humans. Likewise, doctrinal religion and formal science both rely on teaching for their persistence therefore differences are less expected. Folk religion and formal science are what McCauley referred to when he made the argument that religion was natural and science was unnatural, recognizing the folk science that comes naturally to humans. This study focused on McCauley’s distinction and examined reasoning and recall differences between folk religion and formal science.

*Dual-processing theories of reasoning*

The idea of different modes of thought or dual-process theories of information processing has been around a long time. One of the first people to recognize two modes of thought was Brunswik (1956) who identified a certainty-geared strategy and a probability-geared strategy for problem solving. Brunswik described the certainty-geared strategy as based on analytic thinking. The probability-geared strategy was perceptually based. Brunswik conducted experiments involving perceptual size constancy in which participants were instructed to estimate the size of a cube placed at a distance in front of them using only perceptual cues to aid in their answer. He found that the participants had errors that were normally distributed around the mean answer with all answers being close to the true value. A second group of participants were given the same task of estimating the size of a cube but were given a paper and pencil task and enough information to determine the cube size using arithmetic. He found that participants instructed to use a thinking or reasoning approach (a certainty-geared strategy) had irregular errors that were not normally distributed around the mean answer and with some errors being several hundred
times larger than the correct answer. He used these results to support the idea that two levels of
cognition coexist in humans.

Since Brunswik, several researchers in the area of reasoning have proposed similar dual-
process theories to explain the pattern of behavior across individuals in decision making tasks
(Sloman, 1996; Evans & Over, 1996; Evans, 2006; Hammond, 1996; Epstein, 1994; Stanovich
and West, 2000). Hammond (1996) based his Cognitive Continuum Theory (CCT) directly on
Brunswik’s work. Hammond used Brunswik’s terms, intuition and analysis, to describe two
modes of thought that are at opposite ends of a continuum. The middle ground between the
extreme modes of thought is occupied by “quasi-rational” processes and corresponds to
“common sense”, the most common form of cognition. Characteristics of a task environment
influence the mode of processing that will be elicited and therefore tasks can be ordered on a
continuum with regard to their capacity to induce intuition, quasi-rationality, or analytical
cognition. Hammond argued that cognitive activities can move along the continuum over time
so that the components of “quasi-rationality” may change, with success on a task inhibiting
movement and failure on a task stimulating movement.

While Hammond proposed a continuum with intuition and analysis at opposite ends,
other researchers have proposed dual-process theories that regard them as two distinct modes of
thought that interact. Epstein’s (1994) cognitive-experiential self-theory (CEST) emphasized
two interactive modes of information processing, the rational and the experiential. The
experiential system is emotionally driven and assumed to have a long evolutionary history. The
rational system is a verbal inferential system with a very brief evolutionary history. Behavior is
thought to be a product of the joint operation of the two systems. But the dominance of one
system over the other is determined by such factors as individual differences in thinking style
and situational variables. Epstein thought that emotional arousal and a history of relevant experience shift the influence in the direction of the experiential system. In most cases the experiential system is dominant because it is less effortful and more efficient and therefore the default. The experiential system is a concrete, natural system that is adaptive and may be “smarter” in some situations than the rational system. Using a self-report questionnaire on individual differences in thinking style, Epstein found that experiential and rational thinking were uncorrelated and each system of thinking established different coherent patterns of relations with other variables. These results, he argued, were evidence that experiential and rational thinking were not opposite ends of a single dimension but were two interactive systems of information processing.

Evans & Over (1996) proposed a dual-process theory similar to Epstein’s in which reasoning is divided up into two systems, System 1 (heuristic) and System 2 (analytic). System 1 is based on experience, beliefs, and background knowledge; it achieves goals without necessarily an accompanying awareness. Evans & Over generally describe it as heuristically based. System 2 is sequential, controllable, and makes high demands on working memory. Compared to System 1 it is slow but allows for flexibility and controllability. Evans & Over generally describe System 2 as analytically based. The theory is very similar to Epstein’s in its distinctions and the capabilities of each system.

Stanovich and West (2000) described the general similarities of several dual-processing theories by listing the common properties of what they label as System 1 and System 2 thinking. Stanovich and West characterized System 1 thinking as automatic, largely unconscious and relatively undemanding of computational capacity. System 2 thinking is controlled, demanding of cognitive capacity, and acquired by cultural and formal tuition.
Brunswik’s work, Epstein’s cognitive-experiential self-theory, Evans & Over’s System 1 and System 2 theory, as well as Stanovich & West’s description of two information processing systems are all related to the distinction between science and religion by McCauley (2000). One system of thinking is experiential, intuitive, emotional, and belief based which is similar to McCauley’s description of the cognitive aspects of religion. Another system is characterized as cognitive, analytic, and reasoning based which corresponds to McCauley’s description of science. Thus, research that has looked at differences in reasoning in light of the dual-processing theories could help to further illuminate the differences between science and religion.

*Differences in reasoning*

In a test of Epstein’s theory, Denes-Raj & Epstein (1994) presented a conflict between the two processing modes in the context of a game of chance. Participants were offered an opportunity to win $1 on every trial in which they drew a red jelly bean from a bowl containing red and white jelly beans. They presented participants with bowls of jelly beans that offered unequal probabilities of winning. One small bowl (10 jelly beans) and one large bowl (100 jelly beans) were presented. The small bowl offered a 10% chance of winning whereas the large bowl offered a 5% to 9% (varied by trial) chance of winning. Participants had to choose which bowl they would rather pick a jelly bean from. They found that most participants responded with the non-optimal choice, picking the bowl with the larger number of jelly beans even though it offered a smaller probability of winning. Participants chose the non-optimal bowl while acknowledging they knew it was foolish to do so. The evidence of conflict in making choices supports the idea of two different processing systems and suggests that the experiential system can override the rational system even when subjects know the appropriate rational response.
Klaczynski & Robinson (2000) explored age-related differences in everyday reasoning biases based on dual-process theories of reasoning. They assessed reasoning bias on two skills, one involving the law of large numbers, which states that the certainty of inferences that can be made about a population increases as the sample size drawn from that population increases, and one involving the ability to detect flaws in hypothetical research. They used two social domains, religion and social class, and constructed vignettes that contained descriptions of hypothetical research designed to elicit one of the types of reasoning skills. For example, one of the vignettes for an experimental reasoning problem in the religion domain was as follows:

“Two well-known researchers have conducted several studies on the relationship between one’s religion and the tendency to conform to authority. The Catholic and Lutheran religions were compared in one study. At the time, Catholics were hard to locate and contact. Thus, the researchers recruited 50 Catholics from a conference on leadership that was taking place in a nearby city. Next, each person was brought to the researcher’s laboratory. At the laboratory, both the Catholics and the Lutherans were given several orders to complete menial tasks. For example, they were ordered to grade the papers of several dozen undergraduates. At the completion of the experiment, the researchers found that the Lutherans were far more likely to obey the commands than were the Catholics. The Lutherans [sic- should be “Catholics”] were much more likely to question the commands and to refuse. The researchers concluded that the experience of being a Catholic results in a greater sense of independence and of inner strength than does being a Lutheran.”

After reading the vignettes, participants rated the strength of the conclusion, the validity of the research or persuasiveness of the argument (depending on condition, law of large numbers or flaws in hypothetical research) and then wrote justifications for their ratings. They also collected demographic information from the participants. They found that intellectual ability was not related to bias in reasoning, and that biased reasoning was more common in middle-aged and older adults than among young adults. The findings also showed that the tendency to rely on what they call heuristic (experiential, System 1) processing increased with age. These results support the dual-process view of reasoning.
The study had some methodological problems, however. For example, no filler items were used which could help to mask the purpose of the study and prevent participants from identifying patterns in the stimuli. There were also confounded variables such as religious affiliation and prejudice which were not adequately addressed, nor were possible cohort effects among participants of the same age addressed. Despite these problems, the study does present a novel procedure for assessing reasoning processes. Presenting stories with conclusions that favor one type of processing over the other, and asking participants to evaluate the argument, allows one to see which process of reasoning is being used. While age related biases are not relevant to the religion versus science differences, the experimental paradigm may be useful for investigating such differences.

Edwards & Smith (1996) studied a phenomenon known as the prior belief effect in which individuals are incapable of evaluating the strength of an argument independently of their prior belief in the conclusion. Views of the participants about such issues as the death penalty, abortion, and gay marriage were gathered prior to participation, to control for compatibility of argument. Edwards & Smith used an argument evaluation task and found that arguments were examined longer and judged to be weaker arguments if they were incompatible with prior beliefs. They proposed a disconfirmation model of argument assessment. When presented with an argument, automatic activation will occur for memory of the material. If the argument is incompatible with prior beliefs, one will have to search memory for material to undermine the argument, requiring extensive processing. The outputs of the memory search are incorporated into the judgment and evaluation of the argument. The model leads to several predictions. Because memory searches are time consuming, people should take longer to evaluate arguments that are incompatible with prior beliefs than arguments that are compatible with prior beliefs.
Participants should thus report more material when the argument is incompatible with their beliefs because there is more search in memory. Most reported material will be compatible with prior beliefs because initial activation of memory retrieves mainly prior beliefs. Edwards & Smith found support for these predictions and concluded that people were unable to judge the strength of an argument independently of their prior belief in the conclusion, with a bias to disconfirm arguments incompatible with their own views.

The disconfirmation model of Edwards & Smith (1996) made strong predictions which were supported. Their predictions and data are related to dual-processing theory and to the data described in the Klaczynski & Robinson (2000) paper. In both studies, scientific reasoning (more effortful, analytical, System 2) was used to reject evidence that contradicted prior beliefs, whereas the heuristic processing system (less effortful, experiential, System 1) yielded judgments that supported stereotype based beliefs, felt intuitively correct, and was used to accept belief-consistent evidence.

Differences in memory

Previous work in the cognition of religion literature has looked at the important effects context can have on the memorability and transmissibility of concepts (Barrett & Nyhof, 2001; Boyer & Ramble, 2001; Gonce, Upal, Slone & Tweney, 2006; Upal, Gonce, Slone & Tweney, in press). Such research has found recall effects based on counterintuitiveness. Minimally counterintuitive concepts, concepts that violate only one intuitive presupposition about a concept, were found to have a level of recall similar to intuitive concepts when both were embedded in stories. However, a recall advantage of minimally counterintuitive concepts over intuitive concepts was evident at a two week delay. The recall advantage is known as the minimal counterintuitiveness effect. Additionally, other research has found that participants
preferentially choose minimally counterintuitive concepts over intuitive and maximally counterintuitive concepts, those that violated two intuitive presuppositions, when creating stories (Tweney, Upal, Gonce, Slone & Edwards, 2006).

Furthermore, context effects of these types of items are directly related to the memorability hypothesis proposed by Upal et al. (in press) which emphasizes the importance of the properties of an item’s surrounding context rather than the properties of the item itself. Highly memorable concepts are said to be low in predictability and high in postdictability where predictability is the ease with which the occurrence of a concept can be predicted prior to the concept being read, and postdictability is the ease with which a concept’s inclusion can be justified after reading the text including the item. Minimally counterintuitive items have a higher (postdictability - predictability) value than intuitive items, thus making them more memorable. Therefore, minimally counterintuitive items should have better overall recall. Based on this work, one of the present studies (Study 1) looked directly at the recall of minimally counterintuitive and intuitive items presented in either a religion or science context.

Religious individuals versus scientific individuals

Some research has looked at individual characteristics and personality factors that are associated with people within religion or science. However, the studies have been isolated, looking at either factors associated with religion or factors associated with science. Saroglou (2002) reviewed several studies on the Five Factor Model (FFM) of personality and religion and found that Agreeableness and Conscientiousness were two factors most related to religiosity. Agreeableness was associated with being sympathetic, trusting, cooperative, modest, and straightforward (Graziano & Eisenberg, 1997) and Conscientiousness was associated with being diligent, well-organized, punctual, and dependable (Hogan & Ones, 1997). Saroglou also found
that intrinsic religiosity (personal motivation for religious practice) was associated with
Extraversion which is characterized as outgoing, sociable, upbeat, friendly, assertive, and
gregarious (Watson & Clark, 1997). Saroglou hypothesized that the association with
Extraversion may be because, today, expressions of religiosity present a more extraverted form
than in the past. It should be noted, however, that the effect sizes of these results were small.

Ross, Francis, & Craig (2005) looked at the relationship between dogmatism, religion,
and psychological type utilizing the Myers-Briggs Type Indicator. They found that high
dogmatism scores or the extent to which beliefs are open or closed were associated with sensing
over intuition, judging over perceiving, and extraversion over introversion. In other words,
higher dogmatism scores were associated with a focus on specific content (sensing), need for
closure (judging), and deriving energy from the outer world through interactions with others
(extraversion). The association between dogmatism and extraversion is consistent with
Saroglou’s finding that intrinsic religiosity is associated with extraversion.

Feist (1998) conducted a meta-analysis on personality and scientific interest, just as
Saroglou did with personality and religion. Again the Five Factor Model was used and it was
found that the personality factors that make science interest more likely were Conscientiousness,
low Openness, and Introversion. Low Openness was associated with being conventional, rigid
and socialized. Introversion was associated with being reserved and dependent (Feist, 2006).
Differences were found within science based on the type of scientist one was. For example,
physical scientists were more extreme introverts whereas social scientists were more extraverted.
From this review, personality characteristics associated with science appear to be both similar
and different to personality characteristics associated with religion. Conscientiousness was
associated with both; however religion was associated with extraversion whereas science, in general, was associated with introversion.

Given that research has found that different personality traits were somewhat associated with religion and science, the present studies could see differences in performance based on an individual’s orientation toward religion and science if the measures used to classify those individuals were reliable and valid.

**Present studies**

The methods and predictions of the Edwards & Smith (1996) study can be coupled with those of the Klaczynski & Robinson (2000) study to yield an effective design to investigate the differences in processing used within a science or religion context. The present work explored differences between types of context on processing and recall, thus expanding the previous findings in the area of cognition and religion. Specifically, reasoning and recall was investigated within a science or religion context with the hypothesis that context elicits one type of processing over the other thus producing different effects on judgment and memory.

Although the main purpose of the present studies was to look at differences in processing and recall across contexts, an individual’s background in science and religion may affect their responding. The present studies explored the interaction of individual characteristics with processing and recall by using a demographic questionnaire, Religious Orientation Scale-Revised, and a newly constructed Scientific Attitude Assessment scale which allowed individuals to be classified. Such classifications allowed further predictions to be made about types of individuals’ behavior in different contexts.

A distinction should be made between ways of thinking within different contexts and modes of thinking that characterize an individual’s orientation to domains of knowledge. The
present studies were mainly investigating ways of thinking as exhibited through System 1 and System 2 processing, hypothesizing that the religion and science contexts could affect reasoning and recall differently. The context manipulation across individuals examined ways of thinking by looking specifically at religious thinking and scientific thinking. A secondary goal of the present studies was to look at the modes of thinking that different individuals may use across domains of knowledge. An individual characteristic classification examined modes of knowledge specifically by looking at religious individual’s orientation and scientific individuals’ attitudes. A known scale was used to evaluate religious orientation but a scale had to be developed for evaluating an individual’s scientific interest; therefore this goal of the study was exploratory.
STUDY 1A

Based on the hypothesis that context favors different types of processing (System 1 or System 2), minimally counterintuitive items and intuitive items presented in both science and religion contexts may have different levels of recall or interact with recall. If the science contexts elicit a deeper processing as hypothesized, items placed in a science based context should have better recall than those same items placed in a religion context. It is also possible that participants may recall items in one context better than items in the other based on the item’s compatibility with the participant’s prior beliefs. This exploratory hypothesis was examined through analysis of a demographic questionnaire and religion and science orientation scales which were aimed at obtaining strength of science and religious affiliation.

The memorability hypothesis (Upal et al., in press) leads to the predictions that minimally counterintuitive items in both contexts could be recalled better overall and that there could be differences in recall as a function of religion and science orientation ratings on the demographic questionnaire. All participants should have the same level of predictability before reading a context for an item. However, the postdictability (how justifiable the item is after reading the context) could vary by type of context for each individual’s orientation. For example, those participants high in religion may have a lower postdictability for a science context as compared to a religion context. The participant’s background could make items in a religion context more memorable for an individual high in religion, which is contrary to the incompatibility hypothesis stated above.
Method

Participants

Participants were recruited from Bowling Green State University via Experimetrix, a web based recruiting system. There were 39 participants (9 male, 30 female). All participants received course credit for their participation.

Materials

Materials consisted of packets containing minimally counterintuitive and intuitive items adapted from the Gonce et al. study of the role of context on recall. Each item was presented either in a religion context or science context. These two types of items were included because of their similar recall in previous work. An example of a minimally counterintuitive item in a science context is as follows: “Sobbing seaweeds. The sobbing seaweeds of Polynesia were recently discovered by oceanographers. They get their name from the sobbing sound that is produced as the ocean waves pass through them.” The religion context of the same minimally counterintuitive item is as follows:

Sobbing seaweeds. The sobbing seaweeds of the Dead Sea were recently brought to the attention of many around the world. They grow in the spot where Jesus is said to have walked on water and get their name from local Christians who frequent the spot and claim to hear the seaweeds weep for Christ.

Packets consisted of an instructions page, followed by a page containing four topics, a page of math problems, a page for recall, a second page containing four different topics, another page of math problems and finally another sheet for recall.

Questionnaire/Scales.

A demographic questionnaire (Appendix A) was administered asking for age, sex, major, GPA, and various questions regarding religious beliefs and activities as well as science oriented
activities. These questions were designed to ascertain the participants’ background in science and religion which could influence their performance on the task.

The Religious Orientation Scale-Revised (ROS-R) (Gorsuch & McPherson, 1989) (Appendix B) was also administered in order to determine the extent of intrinsic and extrinsic religious orientation for participants. The scale measured the intrinsic and extrinsic religious orientation of an individual, and was originally proposed by Allport (1950). It was meant to supplement the demographic questionnaire and contribute to the background information about participants.

A Scientific Attitude Assessment (SAA) questionnaire was constructed in order to determine the extent of an individual’s interest in science. It was meant to parallel the Religious Orientation Scale-Revised and rate an individual’s motivation and attitude within science. Questions were constructed based on both the Scientific Attitude Inventory II (Moore & Foy, 1997) which assesses attitude toward science as well as the ROS-R. Since individual differences in performance were exploratory in the current studies, the validity of the constructed measure was not problematic, but the current studies could help determine the validity of the measure for assessing scientific attitudes. The constructed Scientific Attitude Assessment is presented in Appendix C.

Procedure

Participants were given the packets containing equal numbers of item type and context, and instructed to read the instruction sheet as it was read aloud and explained to them. They were instructed to not turn a page until told to do so. After reading the instructions participants were instructed to read each of the topics and contexts on the next page. They were given two minutes to read the contexts. After two minutes, they were instructed to turn to the math
problems and complete as many as possible. They were given one minute for the math problems. After one minute they were instructed to turn the page and recall as many of the topics as they could. They were given two minutes for recall. They were then instructed to turn the page and read the topics. After two minutes, they were instructed to turn the page again and complete as many math problems as possible. After one minute they were instructed to turn the page and recall as many topics as they could. They were given two minutes for recall. After completing the packet, participants were given the demographic questionnaire and scales. Recall was scored for accuracy (0=not accurate, 1=accurate).

**Predictions**

Based on previous work in the cognition of religion literature, intuitive items and minimally counterintuitive items may have similar levels of recall regardless of context type. The dual-processing literature leads to the possibility of items in a science context being recalled better if the context elicits System 2 (hereafter referred to as Analytic) processing whereas religion contexts may have worse recall if the context elicits System 1 (hereafter referred to as Intuitive) processing. Since intuitive items do not need explanation, they may have the same level of recall in both science and religion contexts. However since minimally counterintuitive items need to be explained, there could be differential recall of minimally counterintuitive items in science contexts and religion contexts based on the orientation of the individual. If individuals rated high in faith/religion from the demographic questionnaire and scales recall science contexts better and participants high in science recall religion contexts better, the incompatibility hypothesis would be supported. Conversely, if individuals rated high in faith/religion recall religion contexts better and individuals high in science recall science contexts better, the results would support the memorability hypothesis. Individuals “neutral” on science and religion, high
on both science and religion, or low on both science and religion could have better recall for science contexts if the context elicits Analytic processing as hypothesized. They could also have better recall for religion contexts if the context elicits an Intuitive processing as hypothesized, which would support McCauley’s (2000) proposal that religion is cognitively natural. The memorability hypothesis would predict similar recall for minimally counterintuitive concepts across the two contexts for these individuals because postdictability is the same for both contexts. The results from these individuals could help determine if type of context (science or religion) influences recall which would expand current research.

Results

Recall

Table 1 shows the mean recall values for Study 1A. A 2 (Context: science, religion) X 2 (Item type: intuitive, minimally counterintuitive) within-subjects ANOVA was carried out on recall accuracy which indicated no significant difference in recall due to context. There was, however a significant difference in recall due to item type, F(1, 35) = 5.712, p < .05, with minimally counterintuitive (MCI) items having an overall mean recall of 1.487 items and intuitive (INT) items having an overall mean recall of 1.653 items.

Table 1

<table>
<thead>
<tr>
<th>Context</th>
<th>Item type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MCI</td>
</tr>
<tr>
<td>Religion</td>
<td>1.487</td>
</tr>
<tr>
<td>Science</td>
<td>1.487</td>
</tr>
</tbody>
</table>

Note. MCI indicates minimally counterintuitive; INT indicates intuitive
Person type

A correlation analysis was carried out between the strength in faith and interest in science ratings from the demographic questionnaire and the intrinsic and extrinsic scales of the ROS-R and SAA. The results of the analysis are presented in Table 2 and revealed a significant positive correlation between strength in faith and both intrinsic and extrinsic ROS-R scores. Additionally, a significant positive correlation is shown between interest in science and intrinsic and extrinsic SAA scores. These results clearly indicate that the religion items were closely correlated and the science items were closely correlated. Furthermore, the correlations between religion and science items were near zero and not significant with the exception of the correlation between the ROS-R extrinsic score and the SAA extrinsic score. This significant correlation is much smaller than the correlation among religion items and science items which alone does not indicate that religion and science items were correlated with each other. Taken together, these results indicate the two scales were orthogonal, although they were roughly parallel in construction. Cronbach’s alpha was also computed for the SAA and ROS-R as an index of reliability, which yielded alphas of .791 and .827, respectively, indicating the scales to be reliable. A median split was carried out for the intrinsic scores on the ROS-R and SAA which enabled each participant to be classified as high or low on religion and high or low on science. This split led to 4 classifications of participants (Person type): high religion, high science; high religion, low science; low religion, high science; low religion, low science.
Table 2

*Intercorrelations Between the Strength in Faith and Interest in Science Ratings from the Demographic Questionnaire and the Intrinsic and Extrinsic Scales of the ROS-R and SAA for Study 1A*

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Strength in faith</td>
<td>--</td>
<td>.803**</td>
<td>.590**</td>
<td>-.045</td>
<td>-.025</td>
<td>.114</td>
</tr>
<tr>
<td>2. ROS-R (intrinsic)</td>
<td>--</td>
<td></td>
<td>.579**</td>
<td>.033</td>
<td>.025</td>
<td>.160</td>
</tr>
<tr>
<td>3. ROS-R (extrinsic)</td>
<td>--</td>
<td></td>
<td></td>
<td>.156</td>
<td>.134</td>
<td>.366*</td>
</tr>
<tr>
<td>4. Interest in science</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td>.770**</td>
<td>.698**</td>
</tr>
<tr>
<td>5. SAA (intrinsic)</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.752**</td>
</tr>
<tr>
<td>6. SAA (extrinsic)</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. * indicates p < .02; ** indicates p < .001

Table 3 shows the mean recall by Person type, Context, and Item type. A 2 (Context: science, religion) X 2 (Item type: intuitive, minimally counterintuitive) X 4 (Person type: high religion, high science; high religion, low science; low religion, high science; low religion, low science) mixed factor ANOVA was carried out on recall accuracy with Person type as a between subjects factor. There were no significant differences in recall by Context or Item type across Person type. Person type was not a significant factor.
Table 3

*Mean Recall Values by Person Type, Context and Item Type for Study 1A*

<table>
<thead>
<tr>
<th>Person type</th>
<th>Item type</th>
<th>MCI</th>
<th>INT</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Religion</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low religion, low science (N=12)</td>
<td>MCI</td>
<td>1.750</td>
<td>1.917</td>
<td>1.833</td>
</tr>
<tr>
<td></td>
<td>INT</td>
<td>1.125</td>
<td>1.500</td>
<td>1.313</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>1.286</td>
<td>1.429</td>
<td>1.357</td>
</tr>
<tr>
<td>High religion, high science (N=12)</td>
<td>MCI</td>
<td>1.286</td>
<td>1.429</td>
<td>1.429</td>
</tr>
<tr>
<td></td>
<td>INT</td>
<td>1.500</td>
<td>1.750</td>
<td>1.625</td>
</tr>
<tr>
<td><strong>Science</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low religion, low science (N=12)</td>
<td>MCI</td>
<td>1.500</td>
<td>1.500</td>
<td>1.500</td>
</tr>
<tr>
<td></td>
<td>INT</td>
<td>1.500</td>
<td>1.500</td>
<td>1.500</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>1.500</td>
<td>1.750</td>
<td>1.625</td>
</tr>
</tbody>
</table>

*Note.* MCI indicates minimally counterintuitive; INT indicates intuitive

**Discussion**

The significant effect of Item type in recall was expected based on previous work (Barrett & Nyhof, 2001; Boyer & Ramble, 2001; Gonce, et al., 2006), which also found that in immediate recall conditions INT items in context tend to have better recall than MCI items in context. The lack of differences in recall across Contexts does not support the hypothesis that science and religion elicit different types of processing. However, context could be influencing recall for the intuitive items. Remember the memorability hypothesis suggests that since intuitive items do not need explanation, they may have similar recall in both science and religion contexts. Table 1
reveals that this is not the case in Study 1A. The mean recall for INT items in religion context is 1.742 while mean recall for INT items in science context is 1.564. This difference in recall for INT items across contexts is larger than the difference for MCI items across contexts. Following the hypothesis that a religion context is an intuitive context, one could expect an INT item in an intuitive context to have better immediate recall because INT items without context tend to have higher immediate recall (Norenzayan & Atran, 2004; Gonce et al, 2006). The expected higher level of recall for the INT item could be further reinforced by the intuitive religion context. This reinforcement of an INT item with an intuitive religion context could explain the higher level of overall recall for INT items in religion context versus INT items in science context because a science context is not intuitive. Consequently, from the memorability hypothesis, this type of item should have the lowest recall after a delay because it should not be stored in memory.

Although there were no significant differences in recall across Person type, Table 3 shows the means do follow some of the predicted trends. Remember that “neutral” individuals or those high on both science and religion or low on both science and religion, were hypothesized to reveal whether context has an influence on recall since their orientation to science and religion is roughly equivalent. Table 3 shows that both “neutral” groups (low religion, low science and high religion, high science) have a higher level of recall for the religion context. Again, the differences are small and fail to reach significance but this trend does support the hypothesis that religion is cognitively natural as proposed by McCauley (2000). The means of the other two Person types do not follow a predicted trend to support either the incompatibility hypothesis or the memorability hypothesis.

The fact that there were no significant differences in recall by Context or Item type across Person type could be due to several factors. One possibility is that recall of items was almost at
ceiling cross all participants which could lead to only subtle differences across Person type at best. This fact is evidenced by the high means across items. Recall that there were two items for each Item type and Context presented to a given participant, so the maximum value for recall is 2, which is close to all the means presented in Tables 1 and 3. Another possibility for the lack of differences across Person type could be the misclassification among participants. However, the strong correlations between the demographic questionnaire, ROS-R, and SAA as indicated in Table 2, as well as the reliability measures do not support the possibility that classification by Person type was inaccurate.
STUDY 1B

Although no differences were found across contexts in the immediate recall condition of Study 1A, there could be differences in recall after a delay as evidenced in previous work (Gonce, et al., 2006; Norenzayan & Atran, 2004). Again research in the cognition of religion literature has found that minimally counterintuitive concepts have better recall than intuitive concepts after a two week delay when both were embedded in stories or context (Barrett & Nyhof, 2001; Boyer & Ramble, 2001; Gonce, et al., 2006). These results indicate that after a delay, MCI items may have better recall even if INT items had better recall in an immediate condition. Although these differences were across Item type (MCI and INT), differences across Contexts could also be found based on the hypothesis that different contexts (religion or science) elicit different types of processing (Intuitive or Analytic). It may be that one type of context is better for delayed recall due to the type of processing that the context elicits.

Method

Participants

Participants were the same as in Study 1A. They were asked at the end of Study 1A to return in two weeks for an additional related study for which they received experimental credit. A total of 32 participants returned (9 male, 23 female), which is 82% of the 39 participants in Study 1A with 100% of males returning and 77% of females returning.

Materials

Materials consisted of a sheet of paper with instructions and lines for writing responses.

Procedure

Participants were read the instructions and asked to follow along. Participants were instructed to recall their previous session in which they read about various topics. They were
instructed to remember as many of the topics as possible from that previous session and write them on the sheet of paper provided. They were given three minutes for recall.

Predictions

Overall, minimally counterintuitive items were predicted to have higher recall, based on previous work. Participants may show better recall for the items processed Analytically because it entails more demanding, thoughtful processing. However, if participants have better recall for the items processed Intuitively, the results would coincide with the cognition of religion literature which holds that the naturalness or intuitive nature of religion makes it easier to process, remember, and transmit. Context (science or religion) may still interact with orientation as was predicted in the immediate recall of Study 1A.

Results

Recall

Table 4 shows the mean recall values for Study 1B. A 2 (Context: science, religion) X 2 (Item type: intuitive, minimally counterintuitive) within-subjects ANOVA was carried out on recall accuracy which indicated no significant differences between Context or Item type.

Table 4

<table>
<thead>
<tr>
<th>Item type</th>
<th>Context</th>
<th>MCI</th>
<th>INT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Religion</td>
<td>.181</td>
<td>.153</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>.196</td>
<td>.256</td>
<td></td>
</tr>
</tbody>
</table>

Note. MCI indicates minimally counterintuitive; INT indicates intuitive
Table 5 shows the mean recall by Person type, Context, and Item type. A 2 (Context: science, religion) X 2 (Item type: intuitive, minimally counterintuitive) X 4 (Person type: high religion, high science; high religion, low science; low religion, high science; low religion, low science) mixed factor ANOVA was carried out on recall accuracy with Person type as a between subjects factor. There was a significant effect of Person type, F(1, 28) = 4.393, \( p < .05 \) due to the low religion, high science group having no recall for any items. Context and Item type were not significant.

Table 5

<table>
<thead>
<tr>
<th>Person type</th>
<th>MCI</th>
<th>INT</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low religion, low science (N=10)</td>
<td>.500</td>
<td>.500</td>
<td>.500</td>
</tr>
<tr>
<td>Low religion, high science (N=6)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High religion, low science (N=7)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High religion, high science (N=9)</td>
<td>.222</td>
<td>.111</td>
<td>.167</td>
</tr>
</tbody>
</table>

Note. MCI indicates minimally counterintuitive; INT indicates intuitive
Discussion

The lack of differences in recall could be due to possible floor effects. Most participants were not able to recall any of the items presented to them two weeks prior to the delayed recall session. The overall means were all below 0.3 illustrating the lack of recall across participants, since the maximum level of recall again is 2. This indicates that the contexts were either not eliciting different types of processing or the processing differences between contexts did not lead to recall differences after a two week delay. The dramatic differences in recall between immediate and delayed conditions, going from almost ceiling to almost floor, are interesting and may have implications for the contexts the stories were presented in. It is possible that the contexts for the items were supportive enough to allow for the ease of immediate recall but were not interesting and supportive enough to help participants recall them after a delay. It is also possible that science and religion contexts can elicit different types of processing but these contexts and task were not able to accomplish this. The delay could be too long and it is possible that differences could have been clearer at a one week delay when recall might not have been so low.

For the mean recall values by Person type presented in Table 5, it is interesting to see that the two “neutral” groups (low religion, low science and high religion, high science) had high levels of recall across items in both Study 1A and Study 1B. These two groups did have the largest numbers of participants, but this could be an indication that background orientation does have an influence on recall. Again the means across Person type did not support either the incompatibility hypothesis or memorability hypothesis.

Although previous work was partially replicated with science and religion contexts in an immediate recall condition, replication of previous work was not found in a delayed condition.
These results did not support the hypothesis that science and religion contexts elicit different types of processing. The possibility remained however, that differences across science and religion contexts could be found with other tasks that demand more processing.
STUDY 2A

Study 1 investigated context effects in recall whereas Study 2A focused on context effects in reasoning. Epstein’s (1994) theory supposes that behavior in reasoning tasks is a product of the joint operation of analytic and intuitive systems with the dominance of one system over the other being determined by individual differences in thinking style and situational variables. Perhaps individuals are capable of both types of processing during reasoning tasks but use the two types of reasoning to varying degrees based upon individual differences and the context in which a reasoning problem is presented. If McCauley’s cognitive distinction between science and religion is valid, the two different contexts could favor one type of processing over the other. Study 2A looked at such differences in reasoning within and across individuals by having them read stories that describe a situation explained either in a religious manner or in a scientific manner. Participants asserted their agreement with the conclusion to each story (yes/no), their confidence in their answer (7 point scale) and wrote justifications for their responses.

It is important to note that according to Kahneman (2003), System 2 (analytic) generally monitors System 1 (intuitive); therefore System 2 is involved in all judgments because judgments are always intentional and explicit. However, judgments can be labeled *intuitive* or as originating from System 1 if they are not modified by System 2 and therefore reflect the initial proposal/conclusion with little modification (Kahneman, 2003, Kahneman & Frederick, 2005). Given this, religion contexts could favor Intuitive processing and science contexts could favor Analytic processing, due to the similarities between the distinctions made by McCauley and the dual-process theorists. However, since preference for type of processing used may be an individual characteristic, people may also use the same type of processing across contexts. The
administration of the questionnaire aimed at obtaining strength of science and religious affiliation, along with responses to “filler” stories that have neither a science nor a religion context, could help to identify individuals who favor one type of processing over the other. The Religious Orientation Scale-Revised (Gorsuch & McPherson, 1989) and the newly developed Scientific Attitude Assessment used in Study 1 were also administered in order to look at intrinsic and extrinsic religious orientation and attitude toward science.

Method

Participants

Participants were recruited from Bowling Green State University via Experimetrix; a web based recruiting system, advertising through a flier, the campus newspaper, and handouts to classes. There were 59 participants total (24 male, 35 female). Participants received either course credit for their participation or monetary compensation.

Materials

Stories.

A total of 12 stories were created, each containing a “change” scenario in which an event occurred with an implied cause that was explained in the story by a religious character in a religious manner, or by a science oriented character in a science based way. Three types of validity threats were chosen (sample size, control/lack of information, selection) and two stories were created around each of these, for a total of six scenarios. A validity threat was an explicit aspect of the story that could be identified as problematic for the conclusion. Stories within each validity threat type were open to other criticisms but the most explicit threat varied between validity threat types. Three different threats were used so participants could not consistently identify one threat throughout the task. Each of the six scenarios existed in two forms (for a total
of 12), one with a religion based conclusion and one with a science based conclusion. The two forms of the stories (science or religion) differed only in the last sentence in which a character in the story comes to a conclusion or explains the situation. All other aspects of the story were the same. An example story, “Prayer for the terminally ill” reads as follows:

There are two groups of terminally ill patients from the same hospital. Group A consists of three patients and has members of a church praying for them. Group B also consists of three patients but does not have others praying for them. Two members of each group pray for themselves. Everyone receives comparable treatment for their illness. Patients are asked about their pain levels and there is no difference between the average level of pain experienced by the members of Group A and Group B.

The science form then concludes, “The doctor monitoring these patients concludes from this that prayer does not help reduce the suffering of the terminally ill.” The religion form of “Prayer for terminally ill” is the same except for the last sentence which reads “The leader of the church that is praying for patients in Group A believes that God works in mysterious ways and we don’t always know His plan.”

Although each story describes an everyday event, a concern when constructing the stories was how representative the contexts and conclusions were and therefore how generalizable the results would be. The religion stories were a particular concern due to the sensitive nature of religious topics and the fact that initial conclusions seemed to be low in “reason”. These issues were addressed in the following ways. The contexts were made comparable to each other through the parallel construction of the stories with the conclusion being the only difference. The religion stories incorporated a range of religious conclusions including those based on God’s intervention, signs from God, and relationships with God. Additionally, a religious studies professor evaluated the religion based conclusions for acceptability and reasonability and
provided suggestions on wording. These modifications to the stories were intended to make them more representative of the intended contexts and hopefully increased their generalizability.

Six filler stories were created which explained a situation where a conclusion was reached but the conclusion was not based on science or religion, as in the target stories, but rather on a character’s past experience or their “common sense”. Neither religion nor science was used as a basis for the conclusion. An example of a filler story which had only one ending is “Hurricane”:

Recently, there have been more hurricanes that are stronger and more devastating than in years past. There are several theories about why this is so. Some groups of people feel that Mother Nature is punishing people for not taking care of the Earth as they should. Other groups think that it is just a part of the natural pattern of weather over millions of years. Mary is looking through a newspaper that lists points in favor of and against both sides of the issue. She feels that not enough people recycle in the world and that they don’t appreciate the Earth for its beauty. She concludes that Earth is trying to reach a balance to counteract the abuse against it by man.

Filler stories were intended to hide the fact that the target stories were science and religion contexts and thus provided a “neutral” context and a baseline of reasoning. Based on Epstein’s theory (1994) they may help to show if an individual favors one type of thinking style or if their reasoning in an everyday context is a compromise between the two systems. All participants were presented with 12 stories in random order including six neutral filler stories, three religion conclusion target stories, and three science conclusion target stories. All stories are presented in Appendix D.

Lists.

Stories were counterbalanced across two lists such that each list (List 1, List 2) contained three religion conclusion stories, three science conclusion stories and the six neutral filler stories. Each of the target stories had one validity threat and existed in a science form and a religion form. Each List contained two stories with the same validity threat, one in the religion form and
one in the science form. For example, two stories for the validity threat of small sample are “Prayer for the terminally ill” and “Tumor”. One list contained the science form of “Prayer for the terminally ill” and the religion form of “Tumor”. The second list contained the religion form of “Prayer for the terminally ill” and the science form of “Tumor”. Both lists contained the same six filler stories. Participants were randomly assigned to either List 1 or List 2.

**Questionnaire/Scales.**

The response measures presented after each of the stories (Appendix E) read as follows: “Do you agree with the conclusion of the story?”(yes/no) “How confident are you about your answer?”(1=not very confident, 7=very confident). Participants were also asked to provide written justifications for their responses.

A questionnaire (Appendix F) was administered asking participants what they thought the purpose of the study was, if they thought there were similar themes between the stories, and if they thought their responding was influenced in any way. The questionnaire was administered in order to assess any demand characteristics the study may have had which could have led to biased responding.

The demographic questionnaire, Religious Orientation Scale-Revised (ROS-R) and the Scientific Attitude Assessment (SAA) from Study 1A were also administered.

**Procedure**

Participants were shown a total of 12 stories one at a time on a computer screen. Each story was presented in two parts. The first part of the story was presented for participants to read. When they were finished reading they pressed a key to continue. Once the key was pressed, they were presented with the final two sentences of the story which contained the conclusion either in science form or religion form for target stories, or the “neutral” conclusion
for the filler stories. Reading time for both parts of the story was recorded with reading time to the second part being the most critical for analysis.

When they were finished reading the second part of the story, participants again pressed a key to bring up the question which asked whether or not they agreed with the conclusion (yes/no). After responding, the confidence scale was presented which asked how confident they were in their answer (7 point scale, 1=not very confident, 7=very confident). After indicating a confidence level, participants were asked to write justifications for their responses. Justifications were hand written and the time was recorded. Time to write justifications was analyzed and subsequently found to be highly variable due to participants sometimes pausing after writing justifications before continuing on to the next story, therefore, no effects are reported. After completing the written justifications, participants continued to the next story until all 12 were completed. Written justifications were coded (as in the Klaczynski & Robinson, 2000, study) for indication of awareness of validity threat (0= no indication of threat mentioned, 1= indication of threat mentioned but no mention of threat making conclusion impossible, 2= indication of threat mentioned and that the threat made the conclusion impossible or that threat made other conclusions possible), and reference to personal experiences or beliefs (0= no mention of personal experiences or personal beliefs, 1= mention of personal experiences or personal beliefs but no mention of experiences/beliefs affecting the conclusion, 2= mention of personal experiences or personal beliefs and that the experiences/beliefs made the conclusion impossible or other conclusions possible). Additionally, the justifications were given a characteristic coding that identified the reliance on religious or scientific knowledge (0= no mention of scientific or religious “fact”, 1= mention of religious “fact”, for example, reference to the Bible or God’s behavior/characteristics, 2= mention of scientific “fact”, for example, the nature of a disease,
population sampling, 3= mention of both religious and scientific “facts”), which could indicate a bias to use one type of knowledge over the other.

After completion of the story task, participants filled out the purpose of the study questionnaire, the demographic questionnaire, the ROS-R, and the SAA.

Predictions-General

The different contexts of the stories could elicit different processing types within individuals in accordance with Epstein’s theory that situational variables influence which type of processing is dominant. Thus, scientifically oriented materials, in general, were expected to favor Analytic processing and religiously oriented materials, in general, were expected to favor Intuitive processing. Further, reading times to the conclusion of the stories should be faster overall for religion contexts which favor Intuitive processing, as compared to science contexts which favor Analytic processing. The difference in reading times follows because Analytic processing is characterized as entailing deeper processing compared to Intuitive processing (Stanovich & West, 2000).

Additionally, stories processed using Intuitive processing should have fewer justifications overall, with the mean indication of threat coding score falling between zero and one as well as a mean personal experience/belief coding score close to two. Stories processed using Analytic processing should have more justifications overall with a mean indication of threat coding score between one and two as well as a mean personal experience/belief coding score close to zero. Such results would support the idea that science contexts and religion contexts independently elicit one type of processing over the other and favor different ways of evaluating and explaining the world.


*Predictions- Individual Differences*

Independently of the context of the story, type of processing may be dominant in some individuals. Individuals may favor one type of processing over the other due to differences in education, experience, and training which could lead them to use one type of processing more often regardless of the context. The prediction can be confirmed by examining the processing of filler stories. The filler stories should elicit from all participants a compromise between the two processing systems unless an individual favors one type of processing. The demographic questionnaire helped to identify differences among participants that may lead to the use of one processing system over the other as well as aided in the classification of individuals as in Study 1, allowing further predictions to be made. Specifically, individuals rated high in religion/faith and low in science may favor Intuitive processing across stories. Conversely, individuals rated high in science and low in religion/faith may favor Analytic processing across stories. Individuals favoring Intuitive processing should have faster reading times to the conclusions and fewer justifications, regardless of the context, whereas individuals favoring Analytic processing should have longer reading times to the conclusions and more justifications, regardless of context.

Based on the demographic data, individuals low in faith/religion may use Analytic processing on the religion form of the stories if the conclusions are incongruent with their prior beliefs. Conversely, individuals high in faith/religion may use Analytic processing more on the science form of the stories, again, if it is incongruent with their prior beliefs. Based on the findings of Edwards & Smith (1996) on the prior belief effect, participants should take longer to write justifications for their answers when conclusions are incongruent with prior beliefs because a more extensive memory search is required to find evidence to support a belief that is
incongruent with a given conclusion. Individuals “neutral’ on faith/religion and science, or high on both, or low on both may show mixed responding across contexts since some types of stories may be incongruent with their prior beliefs and some may not. Overall, more justifications should be reported when context is belief incongruent with most justifications being congruent with beliefs (Edwards & Smith, 1996). Participants using Intuitive processing should have fewer justifications and more compatible justifications for the type of story they are using Intuitive processing to evaluate. These results are predicted due to the shallower, more automatic processing that is characteristic of Intuitive processing. Such results would help to support the claim that individual differences in type of processing are dominant and may help to identify the characteristics of individuals who favor a particular type of processing.

The Religious Orientation Scale-Revised and the Scientific Attitude Assessment were also used in the classification of individuals, allowing further predictions to be made. Individuals high on intrinsic religious orientation may exhibit the characteristics of Intuitive processing more often than individuals high on extrinsic religious orientation. High extrinsic religious orientation individuals may exhibit characteristics of “neutral” individuals by showing more mixed responding across contexts. Individuals high on positive attitude toward science may exhibit the characteristics of Analytic processing more often than individuals high on negative attitude toward science. High negative attitude toward science individuals may exhibit characteristics of “neutral” individuals by showing more mixed responding across contexts.

Results

Three participants were excluded due to having reading times above 3 standard deviations of the mean in all contexts, perhaps due to computer error or participants not following instructions. This omission left a remaining total of 56 participants (22 male, 34
female). The responses to the purpose of the study questionnaire indicated that participants were not aware of the purpose of the study, therefore no participants were excluded due to their responses on the purpose of the study questionnaire.

Results were analyzed collapsing across participants using item means which yielded no significant results. The lack of significant results using item means may be due to the small number of items. Remember, there were only three religion and three science stories presented to each participant. Therefore, subject means collapsing across items were used in subsequent analyses and are reported.

GPA

Participants' self-reported GPA was analyzed to find possible differences between Lists and Person type. There were no significant differences between the mean GPA for List 1 and List 2 or between the four classifications of Person type, therefore GPA was not considered in further analyses.

Recruitment method

The method of recruitment for each participant, Experimetrix or advertising, was noted in order to examine possible differences between the groups of participants. Overall, 39 participants were recruited from Experimetrix and received course credit for their participation, whereas 17 participants were recruited via advertising and received monetary compensation for participation. Recruitment method was a between subjects factor in all analyses and found to not be a significant factor for any variable, therefore it will not be reported further.

Word count

A regression analysis was carried out to determine if word count to the conclusion of the stories could predict the differences in reading times to the conclusion of the stories. Pilot work
suggested that word count would have no effect on reading time, but the regression analysis combining all three types of Context (religion, science, neutral) revealed that word count did have a significant effect on reading time ($R^2 = 0.163$). Additionally, a regression analysis combining just the two target Contexts (religion, science) was also significant ($R^2 = 0.106$).

However, the average number of words to the conclusions of the stories in each Context (religion, science) for each List was not significantly different (see Table 6). Note that neutral filler stories were identical for each List. Since each participant was only presented one List, the average number of words for each Context was approximately equal within each List, and the average reading time for each Context was analyzed, word count was not included as a separate variable in the ANOVA. Instead, differences across Lists were examined by using List as a between subjects factor.

Table 6

<table>
<thead>
<tr>
<th>Context</th>
<th>List 1</th>
<th>List 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Religion</td>
<td>41</td>
<td>42</td>
</tr>
<tr>
<td>Science</td>
<td>41</td>
<td>38</td>
</tr>
<tr>
<td>Neutral/Filler</td>
<td>36</td>
<td>36</td>
</tr>
</tbody>
</table>

Correlations

A correlation analysis was carried out between the dependent variables in order to determine if they were measuring different aspects of behavior. The results revealed that reading times to story conclusions in all contexts were not significantly correlated with any of the justification coding variables in any context with the exception of reading time to science
conclusions being correlated with characteristic coding in science contexts, Pearson r = .348, p = .009. Since only one correlation was significant, it seems the dependent variables were measuring different aspects of behavior. Therefore, each variable was analyzed separately.

Reading time to story conclusions

A 3 (Context: science, religion, neutral) X 2 (List: 1, 2) mixed factor ANOVA was carried out on reading time to story conclusions with List being a between subjects factor. List was not a significant factor indicating that differences in Context were not due to differences in word count. There was a significant effect of Context, F(2,108) = 38.215, p < .001, with all pairwise comparisons being significantly different. The means, although significantly different, were not in the predicted direction, religion context having the highest reading time to story conclusions. There was also a significant interaction between Context and List, F(2,108) = 7.722, p = .001, which was carried by a large religion List 1 mean, as shown in Figure 1.
Figure 1. Mean reading time to story conclusions across Context by List across all participants. Error bars represent ± 1 standard error of the mean.

The large mean reading time to religion conclusions on List 1 was investigated and found to be due to story number three (pastry cakes) having the greatest mean reading time of the three religion conclusions on List 1 while having 15 fewer words than the longest religion conclusion. In fact, 17 out of 29 participants (59%) had the longest religion reading time to story number three. In order to determine if these reading times were due to specific content aspects of story number three (pastry cakes), reading times to the science conclusions of List 2 were examined, since story number three on List 2 was presented in the science form. Again, story number three (pastry cakes) had the greatest mean reading time of the three science conclusions on List 2.
while having 12 fewer words than the longest science conclusion. This was due to 18 out of 27 participants (67%) having the longest science reading time to story number three.

Given this, the ANOVA was carried out again with story number three removed from both List 1 and List 2. The results indicated that Context again was a significant factor, \(F(2,108) = 22.471, p < .001\), but the Context and List interaction was not significant. List remained not significant. The differences in means for story number three on both Lists and the differences in the analyses indicate that story number three may have been different in some way from the other stories. However, this does not take away from the result that there was a significant effect of Context both with and without including story number three. For the remaining analyses, story number three was included unless otherwise stated.

*Person type*

As in Study 1A, a correlation analysis was carried out between the strength in faith and interest in science ratings from the demographic questionnaire and the intrinsic and extrinsic scales of the ROS-R and SAA. The results of the analysis are presented in Table 7 and revealed a significant positive correlation between strength in faith and both intrinsic and extrinsic ROS-R scores. Additionally, a significant positive correlation was found between interest in science and intrinsic SAA scores. These results indicate that the strength in faith item and interest in science item from the demographic questionnaire were measuring the same dimensions as the ROS-R and SAA. Furthermore, the correlations between the religion items and science items were near zero and not significant, as in Study 1, with the exception of the correlation between the strength in faith and intrinsic SAA score. Again, this one negative correlation does not indicate religion and science items were correlated with each other. Taken together, these results indicate the scales were orthogonal, although they were roughly parallel in construction. Cronbach’s alpha
was also computed for the SAA and ROS-R as an index of reliability, which yielded alphas of .810 and .740, respectively, indicating the scales to be reliable. A median split was carried out for the intrinsic scores on the ROS-R and SAA which enabled each participant to be classified as high or low on religion and high or low on science. This split led to 4 classifications of participants (Person type) as in Study 1A: high religion, high science; high religion, low science; low religion, high science; low religion, low science with almost equal numbers of participants in each group. Table 8 shows the distribution of participants by Person type across Lists.

Table 7

*Intercorrelations Between the Strength in Faith and Interest in Science Ratings from the Demographic Questionnaire and the Intrinsic and Extrinsic Scales of the ROS-R and SAA for Study 2A*

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Strength in faith</td>
<td>--</td>
<td>.701*</td>
<td>.542*</td>
<td>-.033</td>
<td>-.300*</td>
<td>-.129</td>
</tr>
<tr>
<td>2. ROS-R (intrinsic)</td>
<td>--</td>
<td>.608*</td>
<td>-.210</td>
<td>-.262</td>
<td>-.070</td>
<td></td>
</tr>
<tr>
<td>3. ROS-R (extrinsic)</td>
<td>--</td>
<td>-.001</td>
<td>-.022</td>
<td>.234</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Interest in science</td>
<td>--</td>
<td>.754*</td>
<td>.185</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. SAA (intrinsic)</td>
<td>--</td>
<td>.257</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. SAA (extrinsic)</td>
<td>--</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* * indicates p < .05
Table 8

*Distribution of Participants by Person Type Across Lists for Study 2A*

<table>
<thead>
<tr>
<th>Person type</th>
<th>List 1</th>
<th>List 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low religion, low science</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Low religion, high science</td>
<td>6</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>High religion, low science</td>
<td>11</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>High religion, high science</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>27</td>
<td>56</td>
</tr>
</tbody>
</table>

*Reading time to story conclusions by Person type*

Figure 2 shows the mean reading time to story conclusions by Context and Person type. A 3 (Context: science, religion, neutral) X 4 (Person type: high religion, high science; high religion, low science; low religion, high science; low religion, low science) mixed factor ANOVA was carried out on reading time to story conclusions with Person type being a between subjects factor. There was a significant effect of Context, $F(2,104) = 36.419, p < .001$. Person type and the Context by Person type interaction were not significant\(^1\). Additionally, a correlation analysis indicated that reading times to story conclusions in all Contexts were not significantly correlated with the ROS-R, SAA, strength in faith, or interest in science scales with the exception of reading time to the conclusions of science context being significantly negatively correlated with the ROS-R intrinsic score, Pearson $r = -.333, p = .012$. Although significant, the correlation between reading time to science conclusions and ROS-R intrinsic score is small and

\(^1\) The mixed factor ANOVA was also carried out with story number three (pastry cakes) excluded. There was a significant effect of Context, $F(2,104) = 22.601, p < .001$. Person type and the Context by Person type interaction were not significant.
alone does not indicate that differences in reading time to conclusions could be due to Person type characteristics.

![Pareto diagram showing mean reading time to story conclusions by Context and Person type. Error bars represent ± 1 standard error of the mean.](image)

**Figure 2.** Mean reading time to story conclusions by Context and Person type. Error bars represent ± 1 standard error of the mean.

**Justifications**

Justifications were scored by two independent coders for number of justifications, indication of threat, mention of personal experiences or beliefs, and mention of religious or scientific “fact”. To assess inter-coder reliability, percent agreement, Cohen’s Kappa and correlation analyses were carried out. Percent agreement on all measures was 90% or above and Cohen’s Kappa for indication of threat, mention of personal experiences or beliefs, and mention of religious or scientific “fact” were .930, .949, and .811 respectively, which are all above the recommended value of .70. Because Cohen’s Kappa is only appropriate for categorical variables
and number of written justifications was a continuous variable, a correlation was carried out for number of justifications which was .980. These analyses indicate that inter-coder reliability was high. Remaining discrepancies in scoring were resolved through discussion before further analysis.

**Number of justifications**

A 3 (Context: science, religion, neutral) X 2 (List: 1, 2) mixed factor ANOVA was carried out on number of justifications, with List being a between subjects factor. There were no significant effects.

**Number of justifications by Person type**

A 3 (Context: science, religion, neutral) X 4 (Person type: high religion, high science; high religion, low science; low religion, high science; low religion, low science) mixed factor ANOVA was carried out on number of justifications, with Person type being a between subjects factor. Again, there were no significant effects due to Context or Person type, nor an interaction.

**Indication of threat coding**

A 3 (Context: science, religion, neutral) X 2 (List: 1, 2) mixed factor ANOVA was carried out on indication of threat coding, with List being a between subjects factor. List was not a significant factor. There was a significant effect of Context, F(2,108) = 3.750, \( p = .027 \), with pair wise comparisons between religion and science as well as science and neutral/filler being significantly different. The means were in the opposite direction than predicted, religion context having a higher mean threat coding than science context. There was also a significant interaction between Context and List, F(2,108) = 19.219, \( p < .001 \), due to a low mean threat coding on List 1 for religion contexts and high mean threat coding on List 2 for religion contexts. Figure 3 shows the mean threat coding across Contexts by List.
The significant Context by List interaction was investigated further because it was similar to the finding in the analyses for reading time to story conclusions that indicated story number three (pastry cakes) might be different from the other stories. Histograms showing the distribution of coding scores across stories by List were examined. Story number three (pastry cakes) was not found to be unique compared to other stories in the threat coding distribution for either religion or science contexts. However, it was discovered that the threat coding distributions were not normally distributed across stories, and the distributions across Lists were not parallel. In other words, stories in all Contexts across Lists varied in the distribution of threat coding. The biased distribution of threat coding was an indication that the Contexts in the two Lists were not parallel.
**Indication of threat coding by Person type**

Due to the significant Context by List interaction Person type analyses collapsing across Lists were inappropriate. A 3 (Context: science, religion, neutral) X 2 (List: 1, 2) X 4 (Person type: high religion, high science; high religion, low science; low religion, high science; low religion, low science) mixed factor ANOVA was carried out on threat coding with List and Person type being the between subjects factors. There was a significant effect of Context, $F(2,96) = 3.839, p = .025$, with pair wise comparisons between religion and science as well as science and filler being significantly different. The List by Context interaction was significant, $F(2,96) = 17.711, p < .001$, indicating stories were not parallel across Lists which could mask any differences due to Person type. List by Person type and all other interactions were not significant.

**Personal experience coding**

A 3 (Context: science, religion, neutral) X 2 (List: 1, 2) mixed factor ANOVA was carried out on personal experience coding with List being a between subjects factor. There was a significant effect of Context, $F(2,108) = 13.227, p < .001$, with pair wise comparisons between religion and science as well as religion and filler being significantly different. Religion context had the highest mean personal coding as predicted. List was significant, $F(1,54) = 5.769, p = .020$, and the Context by List interaction approached significance, $F(2,108) = 2.913, p = .059$, due to the high mean personal coding in religion context for List 1. The mean personal coding across Context by Lists for all participants is shown in Figure 4. The significant effect of List as well as the Context by List interaction approaching significance indicates that stories were not parallel across Lists.
Figure 4. Mean personal experience coding across Context by List across all participants. Error bars represent ± 1 standard error of the mean.

Personal experience coding by Person type

Due to the Context by List interaction approaching significance and the significant effect of List indicating that stories across Lists were not parallel, Person type analyses collapsing across List were inappropriate. A 3 (Context: science, religion, neutral) X 2 (List: 1, 2) X 4 (Person type: high religion, high science; high religion, low science; low religion, high science; low religion, low science) mixed factor ANOVA was carried out on personal experience coding with List and Person type being the between subjects factors. Context was a significant factor, F(2, 96) = 10.414, p < .001. Person type was also a significant factor, F(3,48) = 2.809, p = .049, indicating there were differences due to Person type. However, List approached significance, F(1,48) = 3.625, p = .063, as well as the Context by List interaction, F(2,96) = 2.440, p = .093,
indicating stories were not parallel across Lists which could be influencing Person type differences. All other interactions were not significant.

**Characteristic coding**

A 3 (Context: science, religion, neutral) X 2 (List: 1, 2) mixed factor ANOVA was carried out on characteristic coding, which evaluated mention of religious or scientific “fact”, with List being a between subjects factor. There were no significant effects. However, most participants had a score of zero for most stories.

**Characteristic coding by Person type**

A 3 (Context: science, religion, neutral) X 4 (Person type: high religion, high science; high religion, low science; low religion, high science; low religion, low science) mixed factor ANOVA was carried out on characteristic coding with Person type being a between subjects factor. Again, there were no significant effects due to most participants having a score of zero for most stories.

**Discussion**

Overall, reading time to story conclusions showed that religion and science were different although not as hypothesized. Religion contexts had the longer mean reading time which was hypothesized to be an indicator of Analytic processing and was expected from science contexts. Reading time did not show Person type differences, which is an indication that differences in reading time were not due to Person type characteristics but rather were a result of processing differences due to context. The significant Context by List interaction for reading time to story conclusions was resolved by removing story number three, which confirmed that the contexts were eliciting different types of processing. Neutral filler stories had similar reading times.
across Person type (see Figure 2) indicating that individuals did not favor one type of processing over the other.

Indication of threat coding also showed that religion and science contexts were different: religion contexts had a higher mean threat coding than science contexts which is consistent with the results of reading time to story conclusions. Indication of threat coding did not show Person type differences. However, analyses indicated Contexts across Lists were not parallel which could not be resolved by removing story number three as in the reading time analyses. The differences across Lists could have masked Person type differences as well as influenced Context effects.

That religion elicited more Analytic processing and science elicited more Intuitive processing may be explained by the structure of the stories. All science stories had an expert such as a doctor, veterinarian, or psychiatrist stating a conclusion, whereas religion stories had non-experts such as a church leader, chaplain, or Bible study group stating a conclusion. The presence of an expert stating a conclusion may have elicited Intuitive processing from participants if they relied on the knowledge of experts and therefore did not critically evaluate a conclusion made by them. Conversely, the non-experts of religion contexts may have elicited more Analytic processing because, although they have knowledge in their area, they do not have the same authority as experts. The reliance on expert knowledge is supported by justifications provided by some participants, which will be discussed further in the General Discussion.

The significant Context and List interactions for reading time to story conclusions and indication of threat coding suggest story variances were present between Lists. The stories for each List may have been different in some way that affected participants’ responses. The analyses for reading time to story conclusions suggested story number three (pastry cakes) may
have been different from the other target stories in both science and religion contexts. It should also be noted that the interactions of List and Context were due to religion context on List 1 having a higher mean reading time and lower mean indication of threat coding (see Figures 1 and 3), which may indicate that religion stories on List 1 were not parallel to religion stories on List 2. List 1 also had the highest number of high religion, low science participants (see Table 8) which may also explain these differences because orientation toward religion in religion context may make stories more interesting (longer reading time) but also less critically evaluated (low indication of threat coding), which suggests that Person type variances as well as story variances may account for the differences across Lists.

Although personal experience coding cannot be fully interpreted due to List and the Context by List interaction approaching significance, personal experience coding showed a significant effect due to Person type that was not present in the reading time to story conclusions or threat justification coding analyses. This significant effect of Person type for personal experience coding suggests references to personal experiences in justifications may be influenced by individual differences, whereas reading time to story conclusions and threat justification coding may reflect processing differences that are independent of individual differences.

Number of justifications and characteristic coding for justifications did not have any significant effects. However, the variance in the number of justifications provided by participants was great independent of context which could have masked differences. Characteristic coding was introduced in this study as a possible indicator of bias and was not based on previous work as the other justification coding variables were. Therefore, the lack of significant differences for characteristic coding could be due to the inadequacy of the variable.
Overall, these results do not have strong implications for the hypotheses because they were not strong predictors of processing compared to reading time to story conclusions and indication of threat coding.

The processing differences shown in Study 2A as well as Person type characteristics could lead to differential recall for story conclusions after a delay. Study 2B was designed to examine recall for story conclusions in light of the processing differences and Person type characteristics of Study 2A with the goal of determining which factor (type of processing or Person type characteristics) played a more important role in remembering material.
STUDY 2B

Previous work (Gonce et al., 2006) found that minimally counterintuitive items in context and intuitive items in context were equally recalled after short delays whereas long delay to recall favored minimally counterintuitive items. The recall advantage is known as the minimal counterintuitiveness effect. In the present study, incompatible conclusions, conclusions that do not match the participants self-ratings on the science and religion scales, could have a recall advantage as with the minimally counterintuitiveness effect. For example, participants who rated themselves high on the religion/faith scales may remember science conclusions better than religion conclusions because such conclusions are counterintuitive with respect to their own beliefs. Conversely, participants who are high on the science scale and low on the religion/faith scales may have better recall for the religion conclusions because the conclusions are counterintuitive with their own conclusions. Thus, recall for material in religion and science contexts may be affected by one’s orientation, either toward or away from religion or science.

Additionally, since differences in processing were found across story contexts, there could be differential recall of story conclusions based on the type of processing elicited by the story context. For example, stories in religion contexts, which seemed to elicit Analytic processing, may have better recall than stories in science contexts, which seemed to elicit Intuitive processing, since Analytic processing is more effortful and demanding of cognitive capacity. The more effortful processing may lead to higher levels of recall for the conclusions after a delay.
Method

Participants

Participants were the same as in Study 2A. They were asked at the end of Study 2A to return in two weeks for an additional related study for which they received either experimental credit or monetary compensation. A total of 36 participants of the 56 participants included in the analyses of Study 2A (14 male, 22 female) returned, yielding a 64% return rate.

Materials

Materials consisted of very brief summary statements presented on a computer screen to remind the participants of the stories. The summary statements for each story are listed in Appendix D. Lined sheets were also provided for participants to write the conclusion as they remembered it.

Procedure

Participants read a summary statement on a computer about one story and then were asked to recall the conclusion of the story as best they could. For example, the summary statement for “Prayer for the terminally ill” read as follows: “There were two groups of terminally ill patients in a hospital with one group being prayed for by members of a church and the other group with no one praying for them. Their pain levels were monitored.” The participants wrote the conclusion as they recalled it. After recalling as much as they could, they were asked if they agreed with the conclusion (yes/no) and to rate how confident they were in their answer (7 point scale). They could press “0” if they were unable to recall the conclusion. Recall was coded for accuracy (0=no recall, 1= the “gist” partly recalled or distorted, 2= the “gist” recalled accurately with some details, 3= the “gist” recalled accurately with many details).
The same procedure continued for all twelve summary statements corresponding to the previously presented 12 stories from Study 2A.

Results

Recall was scored by two independent coders for accuracy. To assess inter-coder reliability, percent agreement and correlation analyses were carried out. Percent agreement for recall accuracy scoring was 93% and the correlation was .950. These analyses indicate that inter-coder reliability was high. Remaining discrepancies in scoring were resolved through discussion before further analysis.

Recall

A 3 (Context: science, religion, neutral) X 2 (List: 1, 2) ANOVA was carried out on recall accuracy with List being a between subjects factor. There was a significant effect of Context, $F(2, 68) = 5.546, p = .006$, due to differences between neutral and religion contexts as well as neutral and science contexts. Religion and science were not significantly different but mean recall values were in the predicted direction with religion contexts having higher recall than science contexts. Figure 5 shows the mean recall accuracy across Contexts. List and the Context by List interaction were not significant.
Mean recall accuracy coding

Figure 5. Mean recall accuracy across Context for all participants in Study 2B. Error bars represent ± 1 standard error of the mean.

Person type

A 3 (Context: science, religion, neutral) X 4 (Person type: high religion, high science; high religion, low science; low religion, high science; low religion, low science) mixed factor ANOVA was carried out on recall accuracy with Person type being a between subjects factor. There was a significant effect of Context, F(2, 64) = 4.267, p = .018. Person type as well as the Context by Person type interaction was not significant. Table 9 shows the number of participants for each Person type classification by List.
Table 9

_Distribution of Participants by Person Type Across Lists for Study 2B_

<table>
<thead>
<tr>
<th>Person type</th>
<th>List 1</th>
<th>List 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low religion, low science</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Low religion, high science</td>
<td>5</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>High religion, low science</td>
<td>6</td>
<td>4</td>
<td>10</td>
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<tr>
<td>High religion, high science</td>
<td>3</td>
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<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>18</td>
<td>18</td>
<td>36</td>
</tr>
</tbody>
</table>

_Correlations_

Correlations were carried out between reading time in Study 2A and recall accuracy in Study 2B as well as the scales on the demographic questionnaire, ROS-R, and SAA. Recall accuracy in Study 2B was not significantly correlated with reading time to story conclusions in Study 2A. Recall accuracy in science context was significantly correlated with SAA extrinsic score, Pearson $r = .435$, $p = .008$, but this small correlation by itself may not indicate any Person type characteristic influencing recall accuracy.

_Discussion_

Overall, the significant effect of Context for recall accuracy was not due to differences between religion and science contexts as had been hypothesized. However, the mean recall accuracy did show a trend in the right direction with religion contexts having a higher mean recall accuracy value than science contexts. This trend supports the hypothesis that Analytic processing rather than Intuitive processing leads to better delayed recall for information. The
high mean recall accuracy value for neutral contexts is perhaps due to the higher probability of
recalling a neutral story, since there were six neutral/filler stories versus three religion and three
science stories presented to each participant. List was not a significant factor and did not interact
with Context therefore, story variance across Lists does not seem to be influencing recall.
Reading time to story conclusions in Study 2A was not significantly correlated with recall
accuracy in Study 2B, indicating that differences in recall were not due to differences in reading
time. This supports the hypothesis that recall was due to processing differences and not reading
time differences.
GENERAL DISCUSSION

The present studies were designed to investigate differences between types of context on processing and recall to test the hypothesis that context elicits one type of processing over the other. Specifically, science context was predicted to elicit Analytic processing whereas religion context was predicted to elicit Intuitive processing. Individual characteristics were hypothesized to influence type of processing independently of context. The results of the recall tasks in Study 1 did not support the hypothesis that context elicits one type of processing over the other. There were no significant differences between science or religion contexts or across Person types, suggesting perhaps that a recall task, such as the one used in Study 1, was not appropriate for eliciting such differences. Therefore, a more cognitively demanding reasoning task was used in Study 2 to investigate the same hypotheses.

Results of the reading times to story conclusions (Study 2A) and recall accuracy (Study 2B) supported the hypothesis that context elicits one type of processing over the other. However, the effect of context was in the opposite direction than expected, because religion context elicited Analytic processing and science context elicited Intuitive processing. A possible explanation for the reversal may be reflected in written justifications, an explanation which will be elaborated further in the discussion.

Significant differences due to Person type were not found in Study 1 or Study 2, though, Person type as a variable was well defined. The ROS-R and SAA were correlated with the scales from the demographic questionnaire indicating they were valid measures of religion and science orientation. Additionally, the ROS-R and SAA were not correlated with each other, indicating separate characteristics were being assessed. Taken together, these aspects of the measures for Person type indicate the classification was an appropriate characterization of individual
orientation. The lack of significant differences due to Person type in the tasks will be addressed further in the discussion.

**Expert reference**

The contrary effect of context may be due to participants relying on experts’ knowledge in the science contexts more than in the religion contexts, which may have led to Intuitive, “non-critical” processing. Justifications for the stories provide several examples of participants referring to expert knowledge when evaluating the conclusion. Story number six (birthmark) will be discussed since it provides the most examples. The first part of the story read as follows:

A farmer who had been in the business of raising cattle noticed one day that a newborn calf was acting strange. He went to see what was the matter, and the calf began to charge at him in anger. This was very unusual because he had never seen a calf do this. They had always been friendly when they are born and would even eat out of his hand. He continued to watch the calf’s strange and angry behavior for a few days. He asked other farmers that came over what to make of the strange behavior but none of them had any ideas. He decided to call the veterinarian who lived up the road to see what he thought. After he called the vet, he heard a bunch of noise outside. His wife was having a Bible study meeting again and decided to show everyone the calf. The vet showed up at the same time the Bible study members noticed an unusual pattern in the calf’s spots.

The religion context conclusion was the following: “The group members exclaimed that it was the mark of the devil that is described in the Bible. They decided to pray for the devil to leave the calf.” The science context conclusion was as follows: “The vet exclaimed that the mark indicated a rare but painfully deadly defect of the intestinal tract, therefore the calf was in terrible pain which caused its aggression. The vet prescribed a medicine that would help.”

The science context conclusion presented a veterinarian claiming the calf’s behavior was due to a disease of the intestinal tract indicated by the strange pattern in its spots. Approximately half of the participants who read this conclusion (14 out of 29) justified their answer by referring to the expert knowledge of the veterinarian. Some examples of justifications reflecting expert
reference include: “…the vet is a professional. If his professional opinion was that the unique mark was an indication of a problem so be it…”(Subject # 21), “Because a vet studied animals and therefore should know such a thing…”(Subject # 37), “The vet most likely knew what he was talking about because he’s been to school and has had to study about animals…”(Subject # 61). Similar reference to the expertise of the veterinarian was also reflected in some religion context justifications of this story as well. The veterinarian was mentioned in both contexts of the story but did not make a concluding statement in the religion context conclusion. Over 20% of participants who were presented the religion context conclusion (6 out of 27) justified their response by indicating the veterinarian should be consulted because of his knowledge. Examples of this type of expert reference include: “…The vet and others should have performed scientific tests on the animal to see what may have been the problem…”(Subject # 38), “…a more likely conclusion could probably be founded by the vet who is an expert in animal behavior…”(Subject # 52), “…But, the vet should look at the calf first to look over a scientific explanation of the behavior of the calf…”(Subject # 68).

These examples from justifications for story number six illustrate that participants may rely on the knowledge of experts in a reasoning task such as the one used in Study 2A. Relying on expert knowledge in this study could influence the effect of context because science and religion contexts did not have similar expert representation throughout the stories: science contexts in this study incorporated the knowledge of experts more than religion contexts. A way to correct this problem could be to have either the same expert come to a science based or religion based conclusion or have a non-expert come to a science based or religion based conclusion. This alteration could make the conclusions in all contexts have similar authority because the same person would be making the conclusion.
The confounding of context with expert’s knowledge has implications for the hypotheses. Thus, an expert’s knowledge may influence type of processing independent of context. By making the stories have similar expert representation, the effect of context could be made clear. If context was a significant factor in stories with similar expert representation, the results could be as predicted with religion contexts eliciting Intuitive processing and science contexts eliciting Analytic processing. However, if there is no effect of context with expert representation accounted for, the hypothesis that different contexts elicit different processing would not be supported and results would indicate that the presence of an expert’s knowledge influences processing more than context. Since Person type differences were not confounded with context or expert’s knowledge, predictions for Person type differences remain the same for stories modified to have similar expert representation.

**Stories**

The significant Context and List interactions for justification coding variables indicated that stories were not comparable across Lists: religion and science stories on List 1 were not equivalent to religion and science stories on List 2. In order to ensure that stories were parallel across Lists and Contexts, future work could add more stories. Since there were only three stories for each Context on each List, variances among the stories could be masking some effects. A larger number of stories could be a more representative sample of the universe of possible stories making idiosyncratic differences due to stories (like pastry cakes) less significant. However, increasing the number of stories is hard because of the amount of time imposed on the participant which could affect focus on the task.

A way to avoid increasing the number of stories is to construct the stories in a more systematic way, taking into account participants’ reliance on expert knowledge. The systematic
construction of stories is also hard but keeps the burden on the participant to a minimum.
Parallelism across stories could ensure that differences were not due to story characteristics which prevented accurate interpretation of context effects and Person type analyses in the current studies.

**Individual Differences**

Although story variances could be masking effects of individual characteristics, there appeared to be no significant differences in reasoning due to Person type, which leads to several possible conclusions. First, the measures used to assess Person type differences may be inadequate. Since the assessment of individual characteristics was exploratory in the present studies, it is possible inappropriate measures were used. However, this does not seem likely given that the ROS-R and SAA had high reliability (as indicted by Cohen’s Kappa) and were highly correlated with the scales from the demographic questionnaire, which indicated validity. Another possible reason for no significant differences due to Person type is that since the scales measured an individual’s motivation toward religion and science, perhaps the wrong characteristics were measured. The scales were adequately measuring intrinsic and extrinsic motivation toward science and religion and differences were found between participants. Thus, the lack of significant differences in processing due to Person type may indicate that other aspects of belief affect processing; these scales may be measuring the wrong aspects of belief in order to see differences due to Person type. Future work could address the inappropriateness of the current measures by exploring individual differences with additional measures such as personality traits.

The distinction between religion and spirituality is related to individual differences because some people may make distinctions between religion and spirituality by identifying
themselves as “spiritual” but not “religious”. The present studies assessed an individual’s intrinsic or extrinsic religious orientation using the ROS-R which identified motivations for participating in religious activities such as going to church and praying. A high intrinsic score on the ROS-R indicated an individual oriented toward religion, an intrinsic motivation to participate in religious activities. The scale did not measure an individual’s spirituality nor did the studies address the issue of spirituality directly because the definitions of religion and spirituality are not distinct or clearly defined. In an attempt to define such terms within the field of psychology of religion, Zinnbauer & Pargament (2005) borrowed the terms and definitions of religion, religiousness, and spirituality from Miller & Thoresen (2003). Religion was defined as an institutional, material phenomenon, whereas religiousness was described in terms of individual belief or practice. Spirituality was vaguely defined as an individual sacred human activity. This distinction between religion and religiousness is similar to the distinction between “doctrinal” religion and “folk” religion in that one is concerned with formal information and the other is concerned with personal belief. The distinction is relevant because the current study focused on “folk” religion and formal science and the description of religiousness is similar to the description of “folk” religion. Therefore, religiousness, in terms of its definition, could be considered the focus of the current studies rather than spirituality. Since the ROS-R measured religiousness, it appears to be a more appropriate measure of behavior relevant to the goals of the present studies. Spirituality may be an important aspect of human personality, but was not the focus of the present studies, therefore was not considered a relevant measure of individual differences.

Finally, the lack of significant differences in reasoning due to individual characteristics leads to the possibility that processing differences between science and religion cut across
individual differences. This result is consistent with De Neys (2006), who argued that there is no
evidence for strong individual differences in the human reasoning machinery. De Neys (2006) attempted to validate the processing assumptions of dual-process theories of reasoning by giving participants a secondary memorization task to complete while performing a syllogistic reasoning task. Participants’ working memory capacity was measured and participants were split into three capacity groups. Since dual-process theories postulate the two systems are characterized by differential involvement of executive working memory resources, burdening the working memory system should only affect reasoning performance on the logic based tasks of the second system (analytic) and not the belief based tasks of the first system (heuristic). De Neys found that burdening executive resources did not affect reasoning performance on heuristic tasks, a finding consistent with the claim that the heuristic system works automatically. However, burdening the executive resources on a task when the belief-based response conflicted with the logic based response decreased reasoning performance, which indicates that analytic processing draws on executive resources. Individual differences in task performance based on working memory capacity were found such that all capacity groups (high, middle, low), had a decrease in performance on conflict tasks due to a demand on executive resources, even in low capacity individuals. Therefore, low capacity individuals are capable of analytic processing but their low working memory capacity is a limitation.

The absence of Person type differences, although contrary to the initial predictions of the present studies, is thus supported by De Neys’ (2006) work. If all participants engaged in both types of reasoning, Person type differences would not be expected based on a participants’ background but rather differences would be expected based only on the material presented (as suggested by Epstein, 1994).
De Neys’ work, however, is inconsistent with other work on reasoning by Stanovich and colleagues (Sa, West, & Stanovich, 1999; Stanovich, 1999), who found individual differences in problem solving reasoning due to dispositions, “relatively stable psychological mechanisms and strategies that tend to generate characteristic behavioral tendencies and tactics” (Stanovich, 1999, p.157). For example, they looked at the tendencies to think in an open-minded fashion and to weigh new evidence against a personal belief—both of which are considered to be dispositions—and found that both accounted for significant differences in problem solving performance even when cognitive capacity was taken into account. Therefore, Stanovich and his colleagues argued that individual differences in disposition could determine differences in reasoning, whereas De Neys argued that only differences in working memory capacity determine differences in reasoning. Individual differences in reasoning due to dispositions are consistent with the predictions of the current studies which predicted individual differences in reasoning based on the fact that different personality traits were found to be somewhat associated with religion and science (Saroglou, 2002; Ross, Francis & Craig, 2005; Feist, 1998). However, individual differences in disposition are not equivalent to orientation as measured in Study 2 and thus may not necessarily indicate that Person type differences should have been seen in Study 2. An individual’s disposition could be independent of one’s orientation toward science or religion. Therefore, unless Person type differences correlated with dispositions, such as those measured by Stanovich and colleagues, Person type differences based on orientation toward science or religion may not be significant. Still, because of the story differences across lists, modifications to the materials are necessary in order to determine if Person type differences are present with the current measures of orientation. Future work could add measures of disposition and
personality to see if they correlate with Person type. This may help to resolve the inconsistencies between De Neys and Stanovich and colleagues.

Conclusion

The present studies were a successful first attempt at characterizing the cognitive differences between science and religion insofar as science and religion were found to elicit different types of processing. The two types of processing, Intuitive and Analytic, as proposed by dual-process theorists, were shown to be a useful distinction for looking at differences in reasoning elicited by type of context. The evidence for processing differences between science and religion thus supports the parallel between dual-process theories of reasoning and McCauley’s (2000) cognitive distinction between science and religion. Support for the parallel indicates McCauley’s distinction was valid and is worth exploring, and this leads to the possibility of investigating context differences in reasoning tasks other than argument evaluation, such as syllogistic reasoning tasks. The parallel between dual-process theories of reasoning and McCauley’s distinction also has implications for theories of reasoning because it suggests that context can influence type of reasoning used. This opens up the possibility of adding context to working memory capacity and individual differences in disposition as possible factors influencing type of reasoning used in a given task. The possibility of processing differences between science and religion opens the door for new theories and research to explore the extent of the differences and what factors influence them.

The present work examined ways of thinking within different contexts and modes of thinking that characterize an individual’s orientation to domains of knowledge. The main focus was on ways of thinking as examined through the context manipulation. Results suggest there is a difference between ways of thinking across contexts because of the differences between
science and religion. Types of thinking used by individuals across domains of knowledge were measured through orientation toward religion and science. The measures successfully classified individuals, although no significant differences were found based on modes of thinking which suggests other aspects of individual characteristics may influence modes of thinking.

Future work could focus on processing differences elicited by science and religion contexts by incorporating the suggested modifications in order to develop a clearer picture illustrating the cognitive differences between science and religion and to determine the extent to which individual differences influence context effects. The results are promising and highly suggestive of the many directions future work could go to determine the extent of possible differences identified by the current findings.
REFERENCES


*Personality and Individual Differences, 32,* 15-25.


APPENDIX A

DEMOGRAPHIC QUESTIONNAIRE

Age _______ Sex M F (circle one)

Major ______________ GPA _____

Do you believe in God? Yes No (circle one)

Do you belong to a church? Yes No (circle one)

If yes, which denomination? _______________________

How often do you attend church services? __________

How strong would you rate your faith? (circle one)

1 2 3 4 5 6 7

Very weak Moderate Very strong

Are you currently taking any science courses in college? Yes No (circle one)

If yes, how many courses? _________

If yes, please list the courses?

How strong would you rate your interest in science? (circle one)

1 2 3 4 5 6 7

Very weak Moderate Very strong

Since entering college, have you formally studied religion (for example, a course on religious history or a Bible study group)? Yes No (circle one)

If yes, how many years? _________

What type of course(s)?
APPENDIX B

RELIGIOUS ORIENTATION SCALE-REVISED

Please read each item and circle the appropriate number describing yourself. If you feel that none of the responses accurately describe you, do not circle a number but please write why you feel this is so.

1 = I strongly disagree  3 = I'm not sure  5 = I strongly agree
2 = I tend to disagree   4 = I tend to agree

1. I enjoy reading about my religion. 1 2 3 4 5
2. I go to church because it helps me make friends. 1 2 3 4 5
3. It doesn't much matter what I believe so long as I'm good. 1 2 3 4 5
4. It is important to me to spend time in private thought and prayer. 1 2 3 4 5
5. I have often had a strong sense of God's presence. 1 2 3 4 5
6. I pray mainly to gain relief and protection. 1 2 3 4 5
7. I try hard to live all my life according to my religious beliefs. 1 2 3 4 5
8. What religion offers me most is comfort in times of trouble and sorrow. 1 2 3 4 5
9. Prayer is for peace and happiness. 1 2 3 4 5
10. Although I am religious, I don't let it affect my daily life. 1 2 3 4 5
11. I go to church mostly to spend time with my friends. 1 2 3 4 5
12. My whole approach to life is based on my religion. 1 2 3 4 5
13. I go to church mainly because I enjoy seeing people I know there. 1 2 3 4 5
14. Although I believe in my religion, many other things are important in life. 1 2 3 4 5

*Note.* Intrinsic items are numbers 1, 3, 4, 5, 7, 10, 12, and 14 with numbers 3 and 14 being reverse scored. Extrinsic items are numbers 2, 6, 8, 9, 11, and 13.
APPENDIX C

SCIENTIFIC ATTITUDE ASSESSMENT

Please read each item and circle the appropriate number describing yourself. If you feel that none of the responses accurately describe you, do not circle a number but please write why you feel this is so.

1 = I strongly disagree  3 = I'm not sure  5 = I strongly agree
2 = I tend to disagree              4 = I tend to agree

1. I enjoy studying science. 1 2 3 4 5
2. I tend to watch television shows about science related topics. 1 2 3 4 5
3. Working in a science laboratory would be fun. 1 2 3 4 5
4. Scientists do not have enough time for their families or for fun. 1 2 3 4 5
5. I would like to be a scientist. 1 2 3 4 5
6. Scientific work is too hard for me. 1 2 3 4 5
7. I take science courses mainly because my friends do. 1 2 3 4 5
8. Scientists have to study too much. 1 2 3 4 5
9. I enjoy reading about science. 1 2 3 4 5
10. Although I study science, many other things are more important in my life. 1 2 3 4 5
11. I study science because I want a well paying job. 1 2 3 4 5
12. I tend to read about science related articles in newspapers and magazines. 1 2 3 4 5
13. What science offers me is an opportunity to have a meaningful career. 1 2 3 4 5
14. I would take a science course that sounded interesting even if it did not fulfill a degree requirement. 1 2 3 4 5

Note. Intrinsic items are numbers 1, 2, 3, 5, 9, 10, 12, and 14 with number 10 being reverse scored. Extrinsic items are numbers 4, 6, 7, 8, 11, and 13.
APPENDIX D

STORIES

Prayer for the terminally ill

There are two groups of terminally ill patients from the same hospital. Group A consists of three patients and has members of a church praying for them. Group B also consists of three patients but does not have others praying for them. Two members of each group pray for themselves. Everyone receives comparable treatment for their illness.

Religion conclusion:

Patients are asked about their pain levels and there is no difference between the average level of pain experienced by the members of Group A and Group B. The leader of the church that is praying for patients in Group A believes God works in mysterious ways and we don’t always know His plan.

Science conclusion:

Patients are asked about their pain levels and there is no difference between the average level of pain experienced by the members of Group A and Group B. The doctor monitoring these patients concludes from this that prayer does not help reduce the suffering of the terminally ill.

Summary statement:

There were two groups of terminally ill patients in a hospital with one group being prayed for by members of a church and the other group with no one praying for them. Their pain levels were monitored.

Validity threat: Small sample
Tumor

Two patients with brain tumors were being treated in a hospital by the same doctor with the same treatment. One was a husband and father who was dedicated to his family and worked hard to provide for them. The other was a single man who lived an exciting life with a carefree attitude. They both shared a room in the hospital. Since the tumors continued to grow while the doctor was determining the best course of treatment, the men each began to hallucinate by hearing a voice speak to them. The doctor explained to them that this sometimes happens with patients in their condition. Both men understood and tried to ignore the hallucinations. But one day the family man “listened” to the voice and thought it was God speaking to him, saying that everything would be all right and not to worry. The man took comfort in this and decided to tell the other man to listen to his “voice” in order to be comforted. The single man said he didn’t believe in God so it wouldn’t matter what the voice was saying. The doctor treating both men thought everything was progressing nicely.

Religion conclusion:

One day after each man was given a treatment the single man had a seizure and died. The hospital chaplain who had been visiting the men daily, wished the single man would have believed in God and asked Him for help with the tumor because he might have lived.

Science conclusion:

One day after each man was given a treatment the single man had a seizure and died. The doctor couldn’t explain what had happened because nothing had changed in treatment and the family man was beginning to improve.

Summary statement:

There were two patients with brain tumors being treated by the same doctor with the same treatment. The single man had a seizure and died.

Validity threat: Small sample
Character transformation

Susan works in a convenience store and therefore sees a lot of people from the neighborhood on a regular basis. But this doesn’t mean she is friends with everyone. She has always been a private person when it comes to personal matters. She was never very friendly with those around her. She would not ignore them but would be very short and not engage in conversation. She also seemed to be irritated if those around her were happy or in a good mood. Recently, she has been unusually nice and friendly to people. She asks how people are doing and seems to want conversation. She herself has been in a good mood and everyone has noticed the change in her.

Religion conclusion:

One day a minister that lives in the neighborhood stopped in the store and noticed the change in Susan right away but said nothing directly to her about it. After leaving the store, the minister thought to himself that Susan must have developed a relationship with God.

Science conclusion:

One day a psychiatrist that lives in the neighborhood stopped in the store and noticed the change in Susan right away but said nothing directly to her about it. After leaving the store, the psychiatrist thought to himself that Susan must have developed a healthy sense of self.

Summary statement:

Susan, a convenience store worker was never really friendly or nice to the neighborhood customers. Recently, she has been more talkative and nice when people come into the store.

Validity threat: Control/ lack of information
Drug use

A drug abuse counselor running a support group decided to do an informal survey. She asked the 20 members of the group if they had ever belonged to a church before they became addicted to drugs. Fourteen members said that they were not members of a church and did not believe in God before they became addicted to drugs. Three members belonged to church even while they were addicted to drugs. Three members had been raised in a church but decided to leave and, shortly after they left, became addicted to drugs.

Religion conclusion:

The counselor, who also studies the Bible concluded that not believing in God or any other kind of higher power puts one at a higher risk of becoming addicted to drugs.

Science conclusion:

The counselor, who also studies psychology, concluded that not believing in God or any other kind of higher power puts one at a higher risk of becoming addicted to drugs.

Summary statement:

A drug abuse counselor is running a support group. He asks the members of the group about their church membership before becoming addicted to drugs.

Validity threat: Control/lack of information
Pastry cakes

A manufacturer of pastry cakes is concerned about how people will like a new product he is about to put on the market. He decides to ask two groups of people what they think of this new product. He decides to recruit people from the local shopping mall. One group is made up of people who were out together shopping for donations to the local children’s shelter. The other group was composed of people who entered the mall and agreed to answer questions. People from the church group claimed to see the face of a famous religious figure in the random pattern of icing on the cake. People from the other group did not mention seeing any faces in the product.

Religion conclusion:

A machine that mass produces these products applies the icing so the manufacturer, a religious man himself, decides that this must be a sign from God. He thanks God for choosing him and does nothing to change the product.

Science conclusion:

A machine that mass produces these products applies the icing so the manufacturer, who is also an engineer, decides that people have overactive imaginations. He makes a minor alteration to the machine to change the product.

Summary statement:

A manufacturer of pastry cakes asks two groups of people about his new product. One group claims to see the face of a famous religious figure in the icing on the cakes.

Validity threat: Selection
Birthmark

A farmer who had been in the business of raising cattle noticed one day that a newborn calf was acting strange. He went to see what was the matter, and the calf began to charge at him in anger. This was very unusual because he had never seen a calf do this. They had always been friendly when they are born and would even eat out of his hand. He continued to watch the calf’s strange and angry behavior for a few days. He asked other farmers that came over what to make of the strange behavior but none of them had any ideas. He decided to call the veterinarian who lived up the road to see what he thought. After he called the vet, he heard a bunch of noise outside. His wife was having a Bible study meeting again and decided to show everyone the calf. The vet showed up at the same time the Bible study members noticed an unusual pattern in the calf’s spots.

Religion conclusion:

The group members exclaimed that it was the mark of the devil that is described in the Bible. They decided to pray for the devil to leave the calf.

Science conclusion:

The vet exclaimed that the mark indicated a rare but painfully deadly defect of the intestinal tract, therefore the calf was in terrible pain which caused its aggression. The vet prescribed a medicine that would help.

Summary statement:

A farmer raising cattle notices a calf that is acting strangely aggressive and decides to call the vet. There was an unusual pattern in the calf’s spots.

Validity threat: Selection
Hurricane

Recently, there have been more hurricanes that are stronger and more devastating than in years past. There are several theories about why this is so. Some groups of people feel that Mother Nature is punishing people for not taking care of the Earth as they should. Other groups think that it is just a part of the natural pattern of weather over millions of years. Mary is looking through a newspaper that lists points in favor of and against both sides of the issue.

Conclusion:

She feels that not enough people recycle in the world and that they don’t appreciate the Earth for its beauty. She concludes that Earth is trying to reach a balance to counteract the abuse against it by man.

Summary statement:

There have recently been more hurricanes that are stronger than ever before. Mary is looking through the newspaper reading about the several theories as to why this is so.

War

A class studying current events is examining the frequency of war in various countries. The professor shows the class statistics on countries which are most frequently engaged in war. Mark, a philosophy major, says that the countries with the highest war rate are those with non-Christian beliefs and maybe this has something to do with it. Katie, an English major, says that Christian beliefs have nothing to do with it and that the location and quality of life in those countries is what matters.

Conclusion:

Dave, another student in the class listens to the arguments on both sides and leaves the class thinking that all of the factors are related and that there is no one cause to the frequency of war in these countries.

Summary statement:

A class studying current events is looking at the frequency of war in various countries. Several theories are proposed by students in the class as to why some countries have higher rates of war than others.
UFO- FILLER

Two friends were hiking in the desert and it started to get dark so they headed toward their car. Just as they approached the car, they heard a sound unlike anything they had ever heard. They looked around and saw a flash of light dart through the sky. Both were amazed by what they had seen. Steve, a pilot thought it must be an aircraft of some kind and Frank, an amateur astronomer thought it must be a comet of some kind. They both got into the car and drove down the road discussing what it might be. As they went through the list of possibilities, they eliminated each one as they went.

Conclusion:
They both finally concluded that it must be an unidentified flying object or UFO. They couldn’t wait to get back and tell their friends.

Summary statement:
Two friends hiking in the desert see a flash of light dart through the sky. On their way home they discuss what they think they might have seen.

Termites- FILLER

A newlywed couple had purchased a new home and had been enjoying the place for several months. Then, for about a week, the couple had been feeling extra tired and weak and was having headaches. After neither one had gotten any better, they decided to see a doctor. The doctor thought their symptoms could be due to a poison of some kind, so the couple had a contractor come to investigate their home. He found a very dangerous gas leak in their water heater and was amazed that the couple had not been killed because the leak was so bad. The leak was fixed and the couple started to get better. Two weeks later they found out they had termites.

Conclusion:
They then realized that the termites must have saved their lives by making tiny holes in the walls of their house which let the poisonous gas escape, saving their lives. They were grateful to have such life saving pests and vowed never to kill bugs again.

Summary statement:
A newlywed couple purchased a new home and several months later became ill. They found out that the water heater was leaking poisonous gas to the point that the contractor couldn’t explain how the couple survived.
Positive thinking

Caroline always believed in positive thinking. She always thought happy things and looked at the brighter side of the situation, even when she was having a bad day. But recently it has been harder and harder for her to find the positive side of some very negative situations she has been in. First, she lost her job and then her favorite cat died suddenly. Just when she thought things had to get better, her car broke down. She decided to try to cheer herself up and went to meet her friend, Laura. Laura was always a good friend but Caroline knew she always saw the negative side of everything, even when good things happened to her. She told Laura what had been going on and Laura suggested that Caroline stop trying to be so positive all of the time in order to not be so disappointed when things weren’t going her way.

Conclusion:

Caroline didn’t say anything at the time, but later thought about what Laura had said. Caroline decided not to think positive anymore in order to avoid being disappointed.

Summary statement:

Caroline, always a positive thinker, had recently run into some bad luck. She found it harder and harder to stay positive so she looked to her friend for support and advice.

Fast food

Sam was a confirmed vegetarian and had never eaten fast food in his life but one day he decided to try some. He went to a local fast food restaurant and enjoyed the food. He was surprised that he enjoyed his meal because he thought that the food was very low quality and he had always heard horror stories about things employees would do to the food. He was scared he would get ill from the food. He felt fine after eating his meal and went home and enjoyed the rest of his evening. Unfortunately, he got really sick the next day and was sick for three days. He was unable to eat any food.

Conclusion:

He found out that some of his friends were also sick around the same time. He vowed never to go to another fast food restaurant even though there was a chance it could have been the flu that was going around.

Summary statement:

Sam, a vegetarian, had never eaten fast food before but decided to try it. After eating it he became sick for several days and was unable to eat any food.
APPENDIX E

QUESTION AND RATING SCALE

Do you agree with the conclusion of the story?  
Yes  No

How confident are you about your answer?

1  2  3  4  5  6  7

Not very confident  Moderately confident  Very confident
APPENDIX F
PURPOSE OF THE STUDY QUESTIONNAIRE

What do you think the study was about?

Did you see any similar themes between the stories? If so, what were they?

Did this influence your responses in any way? If so, how?

Please identify anything else you noticed about the task?