

**AN INVESTIGATION OF THE ROLE OF CONFIRMATION BIAS IN THE
EVALUATION OF INFORMAL REASONING FALLACIES**

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ABSTRACT

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A total of 168 undergraduate students at Temple University provided a measure of their prior beliefs and measures of attitude strength on three topics and then attempted to identify and explain informal reasoning fallacies based on the same topics. Contrary to the hypothesized predictions, prior beliefs and measures of attitude strength did not have a significant effect on participants' ability to accept informal reasoning fallacies consistent with their beliefs based on that topic, although agreement with the topic demonstrated modest effects. Furthermore, this research demonstrated that participants have significant difficulty identifying and explaining informal logical fallacies. Ability to identify and explain one informal fallacy is not a significant predictor of the ability to identify and explain other fallacies. Also, ability to identify and explain one fallacy in a topic is a poor predictor of the ability to identify and explain that fallacy in another topic. This research indicates that formal fallacy syllogism scores were the best predictor of the ability to identify and explain informal logical fallacies, and that agreement with the topic and willingness to act on those beliefs demonstrated modest effects. Consistent with studies on dual-processing theory, in informal logic the individual is forced to examine the information presented in the statement and the

structure of the statement and then relate it to their prior opinions and attitudes about the topic, and therefore, the acceptance of the fallacy is a matter of motivated reasoning bias or self-deception instead of an error in analytical reasoning. Informal reasoning fallacies represented an error in judgment, or a misunderstanding of the validity of an argument.

Practical implications for school psychologists, limitations of this research, and directions for future research were discussed.

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CHAPTER 1

INTRODUCTION

Definitions

Argumentation.

Argumentation is a form of persuasion. Argumentation is the implicit or explicit discussion between two parties that have different positions with respect to the same proposition.

Argumentation is aimed at resolution of the differences between two or more parties by convincing the other party to accept the one's own proposition (van Eemeren, Grootendorst & Henkemans, 2002).

Belief Bias.

Belief bias is a form of confirmation bias and occurs when pre-existing beliefs interfere with an individual's ability to reason validly through a formal argument.

Confirmation Bias.

Confirmation bias is a form of cognitive bias and produces errors in reasoning. When examining evidence relevant to a given belief, people are inclined to confirm preconceptions and avoid information that contradicts prior held beliefs. Information that is consistent with our pre-existing beliefs is often accepted at face value and information that contradicts our pre-existing beliefs is critically scrutinized and discounted (Gilovich, 1991). Individuals essentially see, or interpret, what they expect to see, or interpret.

Epistemology.

Epistemology is the study of what people believe about the acquisition of knowledge, how it occurs, what is accomplished, and how it operates in their lives (Kuhn, Cheney, Weinstock, 2000).

Formal Reasoning.

Formal reasoning concerns itself with conclusions drawn from a set of premises. Formal reasoning does not set a standard for evaluating the premises themselves, only the structure of the conclusions drawn validly or invalidly from a set of premises (Risen & Gilovich, 2007). Fallacies occur in formal reasoning when the premises of the argument do not follow logically to the conclusion.

Informal Reasoning.

Informal reasoning is a form of argumentation used in everyday life that seeks standards for generating and evaluating both the premises of an argument and whether the conclusions are drawn validly or invalidly from a set of premises. Therefore, informal reasoning fallacies are misconceptions in logic that result from faulty reasoning at any point in the reasoning process (Risen & Gilovich, 2007).

Myside Bias.

Myside bias is a phrase coined by Perkins (1989), and a form of confirmation biases describing when an individual is only likely to generate valid arguments for one side of a controversial socially relevant topic.

Syllogism.

A syllogism is a logical appeal first described by Aristotle in *Prior Analytics*. According to Aristotle, a syllogism takes the form of an argument where a conclusive proposition is inferred by two premises. A syllogism is constructed in the form of formal reasoning.

Research Problem

The cognitive study of reasoning, for the last forty years, has focused on the assumption that individuals make logically valid inferences, despite evidence that intelligent

individuals fail to reason logically on relatively simple problems (Thompson, 2004).

Argumentation, or the discussion between two parties who have different positions with respect to the same proposition, occurs in everyday life. Even though individuals commonly engage in argumentation, research has demonstrated that individuals often do not exhibit valid reasoning when engaged in this task. Kuhn (2001) found that about half of individuals engaged in argumentation with informal reasoning did not successfully exhibit valid reasoning. With the goal of persuasion in argumentation, individuals in argumentative discourse provide claims in support of their propositions, which are defended by the presentation of evidence in support of one's own claims or in refutation of another's claim (van Emmeren & Grootendorst, 2004). Psychological studies of logic in argumentation have largely been divided into two ways of inferring from the premises to the conclusion: inductively and deductively. Whereas deductive logic is based solely on the structure of the argument, inductive logic is based upon the degree that the proposition supports the conclusion (Copi & Burgess-Jackson, 1996). The quality of the argument varies based on the validity of the claims. Errors in reasoning that occur during argumentative discourse are referred to as fallacies.

Reasoning is the transition of thought, where one belief or thought provides the foundation for arriving at another belief or thought (Adler, 2008). In formal reasoning, fallacies occur when there is an error in reasoning and the premises of the argument do not follow logically to the conclusion. Since formal reasoning only concerns itself with the conclusions drawn from a set of premises, formal reasoning does not set a standard for evaluating the premises themselves (Risen & Gilovich, 2007). An example of formal reasoning involves the use of logical syllogisms, whereby a conclusion is inferred by two premises. The following syllogism demonstrates this point:

All A's are B's.

C is an A.

Therefore, C is a B.

Informal reasoning seeks standards for generating and evaluating the premises and the reasonableness of the conclusion. Therefore, informal reasoning fallacies are misconceptions in logic that result from faulty reasoning at any point in the reasoning process (Risen & Gilovich, 2007). Informal reasoning fallacies are less defined than formal reasoning fallacies, since informal reasoning fallacies are persuasive, and take the form of appearing valid (Powers, 1995). Examples of informal reasoning fallacies are in Appendix A.

Individuals may invalidly reason through an argument for a number of reasons. Within the psychological literature, one of the main sources of fallacies in logic has been derived from the confirmation bias effect. Gilovich (1991) succinctly summarizes the confirmation bias effect when he states:

When examining evidence relevant to a given belief, people are inclined to see what they expect to see, and conclude what they expect to conclude. Information that is consistent with our pre-existing beliefs is often accepted at face value, whereas evidence that contradicts them is critically scrutinized and discounted (p. 50).

The confirmation bias research has primarily focused on exploring where pre-existing beliefs interfere with an individual's ability to reason validly through a formal argument. The effect of pre-existing beliefs is a form of confirmation bias and referred to as belief-bias when it interferes with the ability to reason validly through a formal argument. The term belief-bias has been the term used in the psychological literature to describe this effect (De Neys, 2006; Evans, Barston, & Pollard, 1983; Gilinsky & Judd, 1994; Handley, Capon, Beveridge, Dennis, & Evans, 2004; Kokis, Macpherson, Toplak, West, & Stanovich, 2002; Markovits & Nantel, 1989; Newstead, Handley, Harley, Wright, & Farrelly, 2004; Sá, West & Stanovich, 1999; Simoneau & Markovits, 2003; Stanovich & West, 1998; Torrens,

Thompson, & Cramer, 1999). Whereas numerous studies have examined the effect of prior beliefs on formal logic, there have been few studies regarding individuals' ability to overcome prior beliefs and attitudes when evaluating informal reasoning fallacies and this area has not been thoroughly investigated. Agreement with a protagonist's opinion on an argumentative issue has shown mixed findings, where with some topics, agreement has interfered with the ability to recognize informal reasoning fallacies (Neuman, 2003), while other studies have failed to replicate these findings (Neuman & Weizman, 2003; Neuman, Glasner, & Weinstock, 2004).

The dual-process model of cognition, first described in the psychological literature by William James (1890), has received attention for an explanation of why individuals fail to validly reason through formal logic when belief is in conflict with logic. Briefly, the dual-processing model of cognition explains differences in reasoning by stating that there are two distinct ways of cognitive processing: a fast, automatic, and unconscious process, and a slow, deliberate, and conscious process (Evans, 2008). The dual-process model of cognition may be important for determining why individuals show a difference in the ability to recognize formal and informal fallacies based on beliefs. The dual-process model of cognition will be further reviewed in the literature review section.

Much of the psychological literature on formal logic has focused on the effect of prior beliefs biasing logical reasoning processes. This research has primarily demonstrated that prior beliefs have a significant impact on individuals' ability to generate accurate logical syllogisms when a belief and validity of the syllogism are in conflict (Feathers, 1964; Sá, West, & Stanovich, 1999). Research has also demonstrated that individuals have difficulty maintaining the form of the syllogism in working memory (Revlin, Leirer, Yopp, & Yopp, 1980), and that working memory plays a significant role in participants' ability to overcome

belief biases (Kokis, Macpherson, Toplak, West, & Stanovich, 2002; Handley, Capon, Beveridge, Dennis, & Evans, 2004), that belief biases occur independent of the form of the syllogism (Evans, Barston, & Pollard, 1983), that developmental trends predict the ability to overcome belief biases (Gilinsky & Judd, 1994), that the belief bias effect exists independently of the reasoner's abstract reasoning ability (Markovits & Nantel, 1989, Sá, West, & Stanovich, 1999), and that belief bias has a large degree of domain generality (Sá, West, & Stanovich, 1999). An alternative theory about why individuals demonstrate this form of confirmation bias suggests that the differences in the ability to overcome belief biases may be due to the inability of participants to generate alternative hypotheses for the conclusion (Torrens, Thompson, & Cramer, 1999).

Fewer studies have systematically investigated the effects of prior beliefs and attitudes on the generation of informal arguments and the rejection of informal logical fallacies. Regarding the generation of informal arguments, Stanovich and West (1997) found that individuals who are able to generate high quality arguments are more objective, more likely to consider alternative hypotheses, and rely less on prior beliefs. Other studies on the generation of informal arguments have found that students are better at providing accurate hypotheses for abstract principles when taking the position of another individual, than when reasoning for themselves (Greenhoot, Semb, Colombo, & Schreiber, 2004). Although individuals reason better for abstract claims, they tend to show in-group favoritism when comparing across groups using informal arguments (Klaczynski, 2000). When asked to provide counterarguments for claims, students with extreme prior attitudes were significantly less likely to generate multiple arguments than individuals with less extreme prior attitudes (Nussbaum & Kardash, 2005). The research has been mixed as to whether agreement with a protagonist's position in an argument has an effect on the ability to evaluate informal logical

fallacies (Neuman, 2003; Neuman & Weizman, 2003; Neuman, Glasner, & Weinstock, 2004). Finally, the research is mixed as to whether education has a significant impact on participants' ability to reason informally (Perkins, 1985; van Gelder, Bissett, & Cumming, 2004).

The ability to reject informal reasoning fallacies has been recently studied in the psychological literature. Specifically, participants' ability to comprehend the text presenting the argument significantly impacted the rejection of informal fallacies (Neuman, 2003), the ability to encode the deep structure of an argument significantly impacted performance (Neuman & Weizman, 2003), the truth-value of the argument significantly affects performance (Neuman, Glasner, & Weinstock, 2004), familiarity with argumentation norms significantly affects performance (Weinstock, Neuman, & Tabak, 2004), and that ability to deductively reason, the understanding of pragmatic knowledge, and personal epistemology significantly affects performance (Ricco, 2007). Motivated reasoning, or the general view that individuals are less skeptical consumers of desirable than undesirable information, has shown that individuals judge belief-consistent information as more valid than belief-inconsistent information (Ditto & Lopez, 1992). Motivated reasoning may be seen as a subset of confirmation bias and may account for a discrepancy in the ability to reject informal logical fallacies when belief is consistent with a protagonist view.

Multiple studies have shown the importance of epistemological level, outlined by Hofer and Pintrich (1997), on the ability to reason informally (Kardash & Scholes, 1996; Kuhn, 1991; Kuhn, Cheney, & Weinstock, 2000; Ricco, 2007; Weinstock & Cronin, 2002). Results indicate that epistemological level is obtained in transitional stages (Kuhn, Cheney, & Weinstock, 2000), that belief in the certainty of knowledge is correlated with prior beliefs (Kardash & Scholes, 1996), and that epistemological level was found to predict participants'

ability to discount alternative choices, generate counterarguments, and offer explanations for alternative decisions (Weinstock & Cronin, 2002). Another factor that impacts an individual's ability to recognize an informal reasoning fallacy is the participant's ability to differentiate explanations and evidence (Brem & Rips, 2000; Kuhn, 2001; Sá, Kelley, Ho, & Stanovich, 2005). These studies have shown that individuals have a difficult time differentiating between non-evidence, pseudoevidence, and evidence for a claim.

Although research into the single-factor model of attitude strength has failed to demonstrate that the dimensions of attitude can be distilled into a single factor (Krosnick, Boninger, Chuan, Berent, & Carnot, 1993), dimensions of attitude strength may play a factor in the ability of participants to reject informal logical fallacies. Studies of attitude strength have revealed that belief-confirming evidence is more readily accepted than belief disconfirming evidence, and that belief polarization generally increases when mixed or inconclusive data are incorporated into a participant's opposing viewpoints (Lord, Ross, & Lepper, 1979). Research has also demonstrated that attitude strength is better predicted by subjective judgments of the participants, or attitude importance, intensity, and certainty, than by cognitive structure dimensions, or attitude thought frequency and prior knowledge (Haddock, Rothman, & Schwarz, 1996). Attitude accessibility (or subjective judgments) only affects reports of individuals with moderate attitudes (Haddock, Rothman, Reber, & Schwarz, 1999). Finally, the perceived strength of one's attitude can be changed based on the mind-set of the individual when a question is posed regarding the attitude. Henderson, de Liver, and Gollwitzer (2008) demonstrated that attitude strength increases significantly when participants have reached a conclusion regarding a position, when compared with individuals who are in the midst of reaching a conclusion.

School psychologists, specifically those trained in the scientist-practitioner model, should be concerned with the development of reasoning skills for several reasons. Firstly, the development of critical thinking skills is fundamental to the application of the scientific method. The critical thinking skills that form the empirical method often involve suspension or rejection of one's prior beliefs in the face of contradictory evidence (Greenhoot, Semb, Colombo, & Schreiber, 2004). Secondly, according to the National Association of School Psychologists *Blueprint for Training and Practice III*, "School psychologists should be good problem solvers who collect information that is relevant for understanding problems, make decisions about appropriate interventions, assess educational outcomes, and help others become accountable for the decisions they make" (Ysseldyke, Burns, Dawson, Kelley, Morrison, Ortiz, Rosenfield, & Telzrow, 2006). Important to the development of the field, the school psychologist should be able to use the empirical method to collect and evaluate information in order to provide appropriate and research-based interventions. With the availability of intervention practices, consumers of intervention information, including parents, teachers and administrators, need help in determining the best strategies for the education of children. Some research has shown that consumers of intervention information have difficulty in selecting the best evidence-based interventions for educational practices. Worrall (1990) argues that individuals who chose treatments of questionable safety or effectiveness for learning disabilities are not fools, unintelligent, or a minority, but instead lack critical thinking skills necessary to make appropriate decisions. The development of critical thinking skills by the school psychologist, in order to aide in the evaluation and selection of appropriate interventions, can help minimize the number of individuals choosing treatments of questionable safety and effectiveness.

Purpose of the Study

The purpose of this study is to investigate whether prior beliefs and attitude strength have an influence on the acceptance or rejection of informal reasoning fallacies in different argument topics. According to the dual-processing theory, it is expected that prior beliefs and attitudes will not affect the performance on informal logical fallacies tasks and formal logical fallacies tasks equally. If the dual-processing is the correct way of distinguishing the ability of individuals to reject fallacious arguments, the dual-processing model will help explain belief biases in formal logical fallacy tasks. According to this model, when beliefs are consistent with a presented fallacy in formal logical fallacy, the heuristic system interferes with processing and the individual is more likely to accept the fallacy. Belief is automatically processed in the heuristic system in dual-processing theory, and therefore will interfere with ability to recognize the fallacy. Formal logical fallacies should show up as an error in analytical reasoning, since formal fallacies can be recognized based solely on the structure of the argument; the information presented in the formal logical fallacy is irrelevant.

Based on the dual-processing theory, informal logical fallacies should be thought of as categorically different than formal logical fallacies. In informal logic, the individual is forced to examine the information presented in the statement and the structure of the statement and then relate it to their prior opinions and attitudes about the topic. Therefore, although attitudes and prior opinions may interfere with correctly identifying the fallacy, the acceptance of the fallacy is a matter of motivated reasoning bias or self-deception instead of an error in analytical reasoning. Instead, informal reasoning fallacies should show up as an error in judgment.

The dual-processing theory would also predict one's inability to recognize the same informal logical fallacies across topics, or at least decrease the chance of an individual

recognizing the structure of the informal reasoning fallacy as invalid. If informal fallacies are accepted based on prior beliefs and attitudes towards a topic, and not the structure of the individual fallacy itself (i.e., an individual is not likely to make an *ad populum* fallacy across domains), then it is hypothesized that recognizing the structure of the fallacy will have less of an effect on acceptance of the fallacy than prior attitudes towards the topic. When viewed through the dual-processing model, ability to reject an informal logical fallacy (based on content) should be moderately positively correlated with one's ability to reject a formal logical fallacy (based on structure), but that the ability to reject a formal logical fallacy will not be the best predictor of the ability to reject an informal logical fallacy. The dual-process model predicts that belief bias will have a strong influence on the evaluation of formal logical fallacies, through the automatic processes of System 1, when the belief and validity of the syllogism are in conflict. In informal logical fallacies, although prior beliefs may have an effect on the evaluation of the fallacy, it is hypothesized that System 2 is activated to account for the informal reasoning (i.e., there is no logical syllogism for System 1 to influence).

Differences in the ability to distinguish informal logical fallacies will be more highly correlated with an individual's attitudes and belief towards the topic than on the form of the informal logical fallacy. If System 2 is activated to account for the informal reasoning in informal logical fallacies, then the strength of the biases should account more for the acceptance of the informal logical fallacy than the form of the informal logical fallacy. That is, it is hypothesized that the participants will reason (System 2) with the content of the informal logical fallacy to decide whether the argument is valid, instead of assessing the form of the informal logical fallacy (e.g., *post-hoc ergo propter hoc* fallacy, *ad populum* fallacy, etc).

Research Hypotheses

Following each Research Question is the Research Hypothesis for this study. The use of the word *Performance* within the Research Question refers to the participant's ability to identify and explain an informal logical fallacy.

Research Question 1.

Are prior beliefs and attitude strength related to participant performance on the informal logical fallacies task?

The purpose of this study is to investigate whether belief bias, in the form of agreement with the argument and attitude strength, has an effect on the acceptance or rejection of informal reasoning fallacies. No previous research has investigated participants' attitude strength (i.e., importance, intensity, certainty, frequency, knowledge) and its relationship to identifying and explaining informal reasoning fallacies. Prior studies have revealed mixed results regarding the participant's agreement with the argument and the rejection of informal logical fallacies (Neuman, 2003; Neuman & Weizman, 2003; Neuman, Glasner, & Weinstock, 2004). It is hypothesized that the strength of one's agreement with the argument and prior beliefs and attitudes, or attitude strength, towards the topic of an argument will be positively correlated with the acceptance of informal logical fallacies based on the argument with undergraduate students. It is hypothesized that the attitude measures, both singly and in combination, will predict participant's performance on the informal logical fallacy task.

Research Question 2.

Do individuals vary in their performance on informal logical fallacies task across fallacy topics?

There are currently no psychological studies that compare multiple informal reasoning fallacies across topics. When comparing performance on the informal logical

fallacy identification task, it is hypothesized that individuals will differ based on the topic of the informal fallacy. That is, it is hypothesized that since attitude strength will affect each topic separately, individuals who perform poorly on one fallacy topic should not necessarily perform poorly across topics.

Research Question 3.

Do individuals vary in their performance on informal logical fallacies across fallacies?

When comparing the performance on the informal logical fallacies, it is hypothesized that participants who incorrectly accept a specific type of fallacy on one task without necessarily accepting the same fallacy in another task. This difference may be due to differing attitude strength across different topics.

Research Question 4.

Does individual performance on the informal logical fallacies task predict performance on the formal logical fallacies task?

Previous research has shown that an individual's ability to correctly identify formal reasoning fallacies accurately predicts performance on informal reasoning fallacies (Ricco, 2007). It is hypothesized that the ability to reject informal logical fallacies is positively correlated with the ability to reject formal logical fallacies.

Research Question 5.

Is agreement with the protagonist's position related to performance on the informal logical fallacies task?

Previous research has demonstrated only one instance when agreement with the protagonist's position (e.g., the existence of God) has significantly impacted the participant's ability to accurately identify informal logical fallacies (Neuman, 2003). It is hypothesized that the participant's agreement with the protagonist's position towards the topic will have no significant effect on the participant's ability to reject informal logical fallacies.

Research Question 6.

Do any of the demographic variables predict performance on the informal logical fallacies task?

It is hypothesized that the demographics variables will not significantly predict performance on the informal logical fallacy task.

Research Question 7.

Do prior attitudes and beliefs, demographic information, or formal logical fallacy identification best predict performance on the informal logical fallacy task?

It is hypothesized that prior attitudes and beliefs, based on attitude strength, will best predict the ability to identify and explain an informal logical fallacy.

CHAPTER 2

LITERATURE REVIEW

Argumentation

Argumentation is the implicit or explicit discussion between two parties that have different positions with respect to the same proposition. Argumentation is aimed at resolution of the differences by convincing the other party to accept one's own proposition (van Eemeren, Grootendorst & Henkemans, 2002). During argumentation discourse, one party tries to convince others based on their *claims*, or the assertions that they seek to establish (Toulmin, 1958). Argumentation can take the role of one party trying to convince another party of its claims, as within a scientific debate, or can take the role of multiple parties trying to convince outside parties of their claims, as in Presidential elections. With the goal of convincing another party, or a third party, to accept one's own proposition, an individual in argumentative discourse provide claims in support of their proposition, which are defended by the presentation of evidence in support of one's claim or in refutation of the other party's claim. Implicit in this definition of argumentation are the notions that argumentation is *verbal*, meaning that it uses language but not necessarily spoken, is a *social* activity, meaning the act of argumentation is directed at others, and is *rational*, or generally based on intellectual considerations (van Eemeren & Grootendorst, 2004).

Arguments are typically divided into two ways of inferring from the premises to the conclusion: inductively and deductively. In every deductive argument, either the premises succeeded or failed in providing conclusive grounds for the truth of the conclusion (Copi & Burgess-Jackson, 1996). Therefore, deductive arguments are either *valid*, when the premises succeed in providing conclusive grounds for the conclusion, or are *invalid*, when the premises do not provide conclusive grounds. If an argument is not valid, it must be invalid, and vice

versa (Copi & Burgess-Jackson, 1996). Inductive arguments are not generally as conclusive as deductive arguments, since inductive arguments do not claim that the premises give conclusive grounds for the truth of the conclusion, but instead provide *some*, or *a degree of*, support for the conclusion (Copi & Burgess-Jackson, 1996). Instead of being judged on the validity of premises by providing conclusive grounds, inductive arguments are evaluated as better or worse, according to the degree of support for the conclusion (Copi & Burgess-Jackson, 1996).

Reasoning is a transition of thought, where one belief or thought provides the foundation for arriving at another belief or thought (Adler, 2008). The structure of the reasoning in an argument can take two forms, formal and informal reasoning. *Formal reasoning*, also referred to in the literature as *formal logic*, is deductive whereby an argument is considered valid if its conclusion follows from the premises, whether the premises are true or not, and invalid if the premises do not follow logically from the conclusion (Risen & Gilovich, 2007). Formal reasoning is deductive and can be evaluated as either valid or invalid. Formal arguments are generally defined as syllogism, or logical appeal, first described by Aristotle in *Prior Analytics*. According to Aristotle, a syllogism takes the form of an argument where a conclusive proposition is inferred by two premises. Specifically, Aristotle stated:

A syllogism is discourse in which, certain things being stated, something other than what is stated follows of necessity from their being so. I mean by the last phrase that they produce the consequence, and by this, that no further term is required from without in order to make the consequence necessary (Jenkinson, 2007, p. 2).

Informal reasoning, also referred to as *informal logic*, occurs when an argument task, its components, and/or its outcomes vary in degree of certainty or acceptance (Voss, 2001). Informal reasoning has been defined as the consideration of “a claim and seeking reasons with a nonformal bearing on the claim, pro or con, in an attempt to resolve the truth of the

claim” (Perkins, 1985, p. 562). Informal reasoning claims are inductive, and are judged based on the degree of support that a premise provides to a conclusion. In contrast to logical reasoning based on mathematics, informal reasoning is based on the certainty or soundness of the argument (Voss, 2001). Informal logic is based upon soundness of the argument or reasonableness of the conclusion, since, unlike formal arguments, informal arguments seek standards for the generation and evaluation of premises (Risen & Gilovich, 2007). The loss of objectivity and precision in the transition from formal arguments to informal arguments is gained in the applicability and utility of use. Most reasoning that people do in everyday life is informal. This reasoning includes decision-making situations that require people to reason out the pros and cons of a decision (Perkins, 1985).

Fallacies in Reasoning and Logic

The evaluation of claims made during discourse can have significant consequences as to the acceptance of the argument. Fallacies, in the logical definition, refer specifically to an error in reasoning or argument (Copi & Burgess-Jackson, 1996). Formal reasoning fallacies occur when there is an error in reasoning and the premises of the arguments do not follow logically to the conclusion. Informal reasoning fallacies, also referred to in the literature as informal logic fallacies, are used for arguments that are, “psychologically persuasive but *logically* incorrect; that *do* as a matter of fact persuade but, given certain argumentative standards, *shouldn't*” (Copi & Burgess-Jackson, 1996, p. 97, italics in original). Therefore, informal reasoning fallacies are not simply made by uneducated people, but are made by nearly all people because the argument appears valid (Risen & Gilovich, 2007). The psychological criterion for ‘appearing valid’ is that “ordinary people are likely to be *taken in* by the *argument* and *think* it is valid or *think* it is good” (Powers, 1995, p. 306, italics in

original). In this way, informal reasoning fallacies are used as rhetorical devices in argumentation (Neuman, 2003), and simply cannot be encoded in standard logic (Oaksford & Hahn, 2004). Although there has been considerable research on formal logical fallacies (De Neys, 2006; Gilinsky & Judd, 1994; Handley, Capon, Beveridge, Dennis, & Evans, 2004; Kokis, Macpherson, Toplak, West, & Stanovich, 2002; Markovits & Nantel, 1989; Newstead, Handley, Harley, Wright, & Farrelly, 2004; Sá, West, & Stanovich, 1999; Simoneau & Markovits, 2003; Stanovich & West, 1998; however, see Torrens, Thompson, & Cramer, 1999), only recently has psychological literature focused on informal logical fallacies (Neuman, 2003; Neuman, Glassner, & Weinstock, 2004; Neuman, Weinstock, & Glassner, 2006; Neuman & Weizman, 2003; Oaksford & Hahn, 2004; Ricco, 2007; Weinstock & Cronin, 2002; Weinstock, Neuman, & Glassner, 2006; Weinstock, Neuman, & Tabak, 2004). Unlike formal reasoning fallacies, research has generally favored the notion that informal reasoning fallacies cannot be detected by examining the form or structure of the argument (Neuman & Weizman, 2003). Informal fallacies can be detected either by examining the context of the argument (i.e., the pragmatics of the argument), or by the content of the argument (i.e., the meaning of words, vagueness). However, Oaksford and Hahn (2004) argue that the structure of an informal argument, with specific types of fallacies, can be analyzed probabilistically to show the acceptability of an argument. When argued from a logician perspective, an informal argument may appear to be fallacious, but be perfectly acceptable when argued from a probabilistic, or Bayesian, perspective. Specifically, the informal argument structure, argument ad ignorantium (argument from ignorance) may be structurally acceptable and valid, but weak due to specific contexts (Oaksford & Hahn, 2004).

The broad definition of informal reasoning fallacies allows for a wide degree of variability in the structure of the fallacious argument. Informal reasoning fallacies can be grouped by or resemble the heuristic that the fallacy represents. A heuristic, as defined in this paper, is “an implicit strategy of judgment that converts a complex inferential problem to a simpler mental assessment” (Risen & Gilovich, 2007, p. 111). Whereas heuristics generally lead to the correct answer, or a close approximation of the correct answer, when stretched too far produce predictable error results. These error results are used to classify the informal reasoning fallacy (e.g., an attack against a person instead of an argument is an *ad hominem* fallacy, a premise that assumes the conclusion is a *circular reasoning* fallacy, a conclusion derived from a lack of opposing evidence to a premise is an *ad ignorantium* fallacy, etc).

The acceptability of informal arguments and formal logic can dissociate, meaning arguments that are logically valid are informally unacceptable and arguments that are logically invalid are informally acceptable (Oaksford & Hahn, 2004). The example provided by Oaksford and Hahn (2004) demonstrates this point: *the key was turned because the car started and if you turn the key the car starts*, is an instance of the logical fallacy of *affirming the consequent*. Although logically fallacious using formal fallacy standards, this argument is informally acceptable because it infers to the best explanation for why the car started (Oaksford & Hahn, 2004).

Several philosophical theorists have proposed models that have attempted to encompass all informal and formal fallacies. Van Eemeren and Grootendorst’s (1987) pragma-dialectical view argues that a fallacy is a violation of a dialectical rule. Powers (1995) defines fallacies as a notion of equivocation or ambiguity, in that although a fallacy appears one way (i.e., as valid), it functions in an invalid way. Ikuenobe (2004) unifies all fallacies under the umbrella of epistemic error in that all fallacies fail to satisfy some standards of adequate justification

and proof. There is currently no consensus on the philosophical theories for a model of all informal and formal fallacies.

The Dual-Process Model of Cognition

The dual-process model of cognition refers to the process of social thinking and behavior that is determined by two different ways of understanding and responding to social stimuli: implicit cognition, also referred to as heuristic (De Neys, 2006) or System 1 (Stanovich, 2008), where behavior is impulsively and unintentionally activated by emotions, habits, or biological drives (Franzoi, 2006), and explicit cognition, also referred to as analytic (De Neys, 2006) or System 2 (Stanovich, 2008), which is an effortful, reflective thinking, where consequences are weighed and evaluated. Dual processing was first described by William James (1890):

Our thought is rational, and leads to a rational act, but it can hardly be called reasoning in a strict sense of the term. There are other shorter flights of thought, single couplings of terms which suggest one another by association, which approach more to what would commonly be classed as acts of reasoning proper (p. 362).

James (1890) made the distinction between *recepts*, or the actions that are taken as part of the adaptive behaviors of daily living and without intelligent reflection (i.e., System 1), and *associative thought*, or reasoning that is *voluntarily* thought and not *immediately suggested by other concrete things* (i.e., System 2) (p. 329, italics in original). According to James, the *associative system* reflects similarity and a temporal structure in reasoning, while the *symbolic system* reflects a rule structure (Sloman, 1996). The idea that reasoning may involve two distinct forms has been explored since the 1970s, although only recently have the theories been integrated into coherent theoretical schemes (Evans, 2002). Although multiple theorists have proposed different models for dual-processing in high cognition, all the theories have made a distinction between fast, automatic, and unconscious processes, and cognitive processes that

are slow, deliberate, and conscious (Evans, 2008). Of the functional characteristics of the two systems, it appears that conscious (System 2) thought is sequential, concrete, contextualized, and domain-specific (Evans, 2008), while the rapid processing and high capacity of System 1 is parallel (Sloman, 1996), abstract, decontextualized, and domain general (Evans, 2008). The notion that System 1 is contextualized is important to the point of belief bias in reasoning. If System 1 processes are contextualized, prior knowledge and belief are automatically integrated when reasoning through formal logic problems.

Confirmation Bias: Belief Bias

In psychological research, the inability to decouple prior knowledge from reasoning processes has been called the belief bias effect (Evans, Barston, & Pollard, 1983). The belief bias effect occurs in formal logical reasoning when participants judge the validity of the formal logical syllogism more accurately when the believability of the conclusion coincides with prior beliefs more than when it conflicts. In turn, the effect of belief bias represents cases when prior knowledge, belief, and opinion serve to disrupt the impartial evaluation of the argument (Sá, West, & Stanovich, 1999). Myside bias, a subset of confirmation bias, refers to the tendency to evaluate and generate evidence, and test hypotheses in a consistent manner to one's prior beliefs (MacPherson & Stanovich, 2008). Strong myside bias has been demonstrated in numerous studies (Baron, 1995; Greenhoot, Semb, Colombo, & Schreiber, 2004; Kuhn, 1991; MacPherson & Stanovich, 2008; Nussbaum & Kardash, 2005; Perkins, 1985; Perkins, Farady, & Bushey, 1991; Stanovich & West, 2007; Toplak & Stanovich, 2003). Although there have been multiple studies examining the effect of belief bias on formal logic (De Neys, 2006; Evans, Barston, & Pollard, 1983; Gilinsky & Judd, 1994; Handley, Capon, Beveridge, Dennis, & Evans, 2004; Kokis, Macpherson, Toplak, West, & Stanovich, 2002;

Markovits & Nantel, 1989; Newstead, Handley, Harley, Wright, & Farrelly, 2004; Sá, West & Stanovich, 1999; Simoneau & Markovits, 2003; Stanovich & West, 1998; Torrens, Thompson, & Cramer, 1999), very few studies have systematically investigated the effect of prior beliefs and attitudes on the acceptance of informal reasoning fallacies. Attitudes will be included in the discussion of belief biases in informal reasoning, since prior beliefs have the potential to influence formal and informal reasoning differently. For example, in formal reasoning, belief biases occur when the conclusion to a syllogism contradicts well-established, definitive knowledge. For example, this unbelievable but logically valid syllogism demonstrates this point:

All vehicles drive on land.

Boats are vehicles.

Therefore, all boats drive on land.

It is commonly held and definitive knowledge that boats use water as a medium for transportation. Although the syllogism is logically valid, research has demonstrated that the prior belief of “boats motor in the water” has an effect on an individual’s ability to recognize the syllogism as logically valid. Conversely, belief bias occurs in logically invalid syllogism, where the conclusion is believable. A believable, but logically invalid syllogism is demonstrated by this example:

All candy has sugar.

Chocolate has sugar.

Therefore, chocolate is candy.

It is commonly held and definitive knowledge that chocolate is candy. In this instance, the prior belief that “chocolate is candy” has an effect on an individual’s ability to recognize that the syllogism is logically invalid. Therefore, belief biases in formal logic occur when the

conclusion of a syllogism contradicts established beliefs when the syllogism is valid, or coincides with established beliefs when the syllogism is invalid. Belief bias is systematically different in informal reasoning. In informal reasoning, instead of deciding whether an argument is valid based on the form or structure of the argument, as in formal reasoning, research has generally favored the hypothesis that informal reasoning fallacies can be detected either by examining the context of the argument (i.e., the pragmatics of the argument), or by the content of the argument (i.e., the meaning of words, vagueness) (Neuman & Weizman, 2003).

Although there have been multiple studies examining the effect of belief bias on formal logic (De Neys, 2006; Evans, Barston, & Pollard, 1983; Feathers, 1964; Gilinsky & Judd, 1994; Handley, Capon, Beveridge, Dennis, & Evans, 2004; Kokis, Macpherson, Toplak, West, & Stanovich, 2002; Markovits & Nantel, 1989; Newstead, Handley, Harley, Wright, & Farrelly, 2004; Sá, West, & Stanovich, 1999; Simoneau & Markovits, 2003; Stanovich & West, 1998; Torrens, Thompson, & Cramer, 1999), very few studies have systematically investigated the effect of belief bias on the acceptance of informal reasoning fallacies.

The purpose of this study is to investigate whether belief bias has an influence on the acceptance or rejection of informal reasoning fallacies in arguments of high value or settings where motivation has an effect on reasoning. It is hypothesized that one's positive attitudes and beliefs towards an argument will be positively correlated with the acceptance of informal reasoning fallacies among undergraduate university students. As viewed through dual-processing theory, prior beliefs and attitudes should not affect the performance on informal fallacy tasks and formal fallacy tasks equally. Using this theory, the dual-process model will help explain belief biases in formal logical fallacy tasks, while not affecting informal fallacy

tasks to the same extent. When belief is consistent with a presented fallacy in formal logical fallacy, the heuristic system interferes with processing and the individual is more likely to accept the fallacy. Belief is automatically processed in the heuristic system in dual-processing theory, and therefore will interfere with the ability to recognize the fallacy. Formal logical fallacies should show up as an error in analytical reasoning, since formal fallacies can be recognized based solely on the structure of the argument; the information presented in the formal logical fallacy is irrelevant.

Based on the dual-processing theory, informal logical fallacies should be thought of as categorically different than formal logical fallacies. In informal logic, the individual is forced to examine the information presented in the statement and the structure of the statement and then relate it to one's prior opinions and attitudes about the topic. Therefore, although attitudes and prior opinions may interfere with correctly identifying the fallacy, the acceptance of the fallacy is a matter of motivated reasoning bias or self-deception instead of an error in analytical reasoning. Instead, informal reasoning fallacies should show up as an error in judgment.

The dual-process theory would also predict one's inability to recognize the same informal logical fallacies across topics, or at least decrease the chance of an individual recognizing the structure of the informal logical fallacy as invalid. If informal fallacies are accepted based on prior beliefs and attitudes towards a topic, and not the structure of the individual fallacy itself (e.g., an individual is not likely to make an *ad populum* fallacy across domains), then it is hypothesized that recognizing the structure of the fallacy will have less of an effect on acceptance of the fallacy than prior attitudes towards the topic.

Dual-Processing Model in Reasoning

Epstein (1994) hypothesized that a cognitive-experiential self-theory existed that explained a model of reasoning using two major systems of adaptation: the rational and experiential. Heuristic processing, or the experiential-intuitive system, refers to the cognitive shortcuts stemming from the emotions that are used for making decisions, which Epstein (1994) argued would be governed by automatic processes that would continually bias rational processing. Toplak and colleagues (2006) argue similarly that the autonomous set of systems (TASS) in the brain are executed rapidly and without volition, are not under conscious control, and are not dependent on analytic system output (System 1). Dual-processing theories have been used to explain “rational thinking failure” by hypothesizing two reasoning systems that posit that the first system (often called the heuristic system) solves problems based on prior beliefs and the second system (often called the analytic system) permits logical reasoning (De Neys, 2000). Stanovich (2008) hypothesizes that the goals of the heuristic system (also known as System 1) and the goals of the analytic system (also known as System 2) are different, and the significant consequences for human reasoning and fulfillment follow directly from this difference. Broadly, the analytic system is more attuned to the person’s needs as a coherent organism, while the heuristic system is more attuned to reproductive goals (Stanovich, 2008). More definitively, Stanovich and West (2008) describe the first system in terms of an analysis that is concerned with the goals of the system, beliefs relevant to attaining the goals, and the rational choice of action considering the goals and beliefs of the system. The second system is therefore concerned with the specific computational processes and information-processing information necessary for task completion. Stanovich (2009) bifurcates the second system into the reflective mind, which

explains individual differences in rational thinking dispositions, and the algorithmic mind, which explains individual differences in fluid intelligence.

The dual-process theory of reasoning is important in the formal and informal logical fallacy literature, since the dual-processing theory may help provide a justification for the differences in one's ability to recognize formal and informal logical fallacies based on prior beliefs. The heuristic system (System 1) will likely interfere with the acceptance of a formal logical fallacy when there is no conflict between prior beliefs and the conclusion of the syllogism. Furthermore, in valid belief-inconsistent syllogistic conclusions, rejection of a valid hypothesis becomes more likely if the heuristic system plays a large part in the analysis of the argument. Research confirms that cognitive load increases when there is a conflict between belief and cognition, supporting the hypothesis that reasoning is mediated by a heuristic or automatic processing system for no-conflict problems (De Neys, 2006).

In order to investigate the hypothesis that two types of processing were used in reasoning, De Neys (2006), examined the ability of participants to complete a standard syllogistic reasoning task, where belief and cognition were either in conflict or not in conflict, by using a secondary task of working memory to investigate the dual-process framework with 208 first-year psychology students from the University of Leuven, Belgium. According to De Neys (2000), on no-conflict problems, the heuristic system is assumed to trigger the correct response, and will not be hindered by executive burden. Furthermore, on conflict problems the analytic system, which draws on executive burden, should be hindered if participants are under an additional working memory task. Measures included a standard syllogistic reasoning task, based on Sá, West, and Stanovich (1999), a dot memory task to increase executive burden during syllogistic reasoning, and a measure of working memory. Students were placed in one of three categories based on scores on the measure of working

memory. Results indicated that performances on automatic, no-conflict problems were not affected by the addition on executive load. Results also indicated that across all working memory levels, executive burden had a significant impact on conflict items, supporting the claim that reasoning is mediated by a system that requires executive working memory resources for proper functioning. This study lends additional support for the dual-process framework for reasoning, and postulates the existence of a heuristic-based automatic processing system for belief-consistent reasoning and an analytic, executive functioning and working memory based processing system for belief-inconsistent reasoning.

Although working memory is implicated in belief-cognition conflict problems, the current research does not suggest that overall cognitive ability plays a significant role in avoiding biases in reasoning. It has been have demonstrated repeatedly that cognitive ability fails to accurately predict biases in reasoning (Stanovich & West, 2007; Stanovich & West, 2008a; Stanovich & West, 2008b; Toplak & Stanovich, 2003).

Belief Bias and Formal Logic

The tendency to base judgments on prior beliefs instead of logical reasoning processes has shown a long history of biasing performance in reasoning tasks (Evans, 2002; Kahneman, Slovic & Tversky, 1982). Significant research has investigated the relationship between belief biases and formal reasoning, primarily demonstrating that prior beliefs have significant impacts on a participant's ability to generate accurate logical syllogisms when the syllogism is in conflict with the belief. Although this may be explained, in part, by a dual-processing system of reasoning, other researchers have hypothesized that belief biases are due to failure in epistemological understanding (Sá, West, & Stanovich, 1999).

Revlin, Leirer, Yopp and Yopp (1980) have hypothesized that belief bias errors are only indirectly related to the syllogism's truth value and not a good measure of reasoning ability. Instead, these researchers argue that belief biases are due to an implicit cognitive conversion when reasoning through a syllogism. For example, when the reasoner is told that "All A are B," the reasoner interprets and encodes the syllogism as it is intended, and also encodes the converse, or "All B are A." According to this model, the conversion will occur when the reasoner's knowledge of the world does not directly conflict with the syllogism (i.e., "All dogs are animals" is not converted to "All animals are dogs"). In this way, Revlin et al. (1980) argue that the influence of personal biases on reasoning is from the reasoner's ability to understand the syllogism, and not from a suspension of rationality. Revlin et al. (1980) found some support to suggest that the conversion of syllogisms in encoding can account for a large part, approximately 70%, of all reasoners' decisions on neutral, abstract, and concrete problems. Furthermore, the researchers demonstrated that when students reason with controversial material, their decisions can be predicted from the encoding of the premise, instead of the premise believability. Revlin et al. (1980) found that only a small proportion of errors were attributed to belief biases in the conclusion. Participants were significantly more likely to state that "no conclusion" was possible than to accept a believed statement over a logically prescribed one. Therefore, these studies demonstrate that belief bias may not be a true representation of an individual's reasoning ability and that conflict between belief and logic may have a small role in overall reasoning ability. When belief biases do have an effect on reasoning, it seems to have a greater effect on the premises of the syllogism than the conclusion.

One early study revealed that prior attitudes could have a significant impact on one's ability to critically evaluate logical syllogisms. Feathers (1964) investigated the effect of

attitude strength of 165 male participants on their ability to evaluate the logical validity of a syllogism argument about religion. Measures included a syllogism task with the validity of the syllogism and the stance on religion mixed (e.g., half were valid/invalid and half were proreligious/antireligious), a religious attitude scale, and two tests of participants' intolerance of ambiguity. Results indicate a significant positive correlation between syllogism evaluation and religious attitude, a significant negative correlation between syllogism evaluation and critical ability scores, and a significant positive correlation between syllogism evaluation and intolerance of ambiguity. Feathers (1964) also found that intolerance of ambiguity was negatively correlated with critical thinking ability, meaning that individuals who were more accepting of ambiguity tended to have greater critical thinking ability. Consistent with Feathers's hypotheses, participants who were more proreligious were significantly more likely to judge invalid proreligious syllogisms as valid, valid antireligious syllogisms as invalid. Alternatively, proreligious participants were more likely to make errors in the proreligious direction, rather than the antireligious direction. For participants in the antireligious group, the syllogism scores were found to be positively correlated with intolerance of ambiguity, which was not the expected direction of the relationship. Although individuals with a high degree of antireligious attitudes may be expected to show this trend, an analysis of the participants in the antireligious group showed that the vast majority of individuals only had mild antireligious attitudes. As expected by the researcher, intolerance of ambiguity was positively correlated with religious attitude for the antireligious group, meaning that individuals with more extreme antireligious attitudes tended to have a lower threshold for ambiguity. This study shows that prior attitudes can have a significant impact on ones ability to evaluate syllogisms critically.

In their first study, Evans, Barston, and Pollard (1983) investigated the relative weight given to belief and logic in the four types of logical syllogisms embedded in prose, controlling for the conversion of premises, with twenty-four undergraduates. The four types of syllogisms are represented as the universal affirmative (A), or “All X are Y,” the particular affirmative (I), or “Some X are Y,” the universal negative (E), or “No X are Y,” and the particular negative (O), or “Some X are not Y.” Across all four types of syllogisms, the experimenters found significant belief bias, where participants accepted syllogisms with conclusion that were believable more readily than conclusions that were not believable, a tendency for participants to accept more valid than invalid arguments, and a significant belief by validity interaction. In their second study, Evans, Barston, and Pollard (1983) extended the understanding of the first experiment by presenting the syllogisms without prose and by asking half of the participants to provide a “think aloud” verbalization of their reasoning. The results of the second experiment were identical to the first, where the experimenters found significant belief bias, where participants accepted syllogisms with conclusions that were more readily believable than conclusions that were not believable, a tendency for participants to accept more valid than invalid arguments, and a significant belief by validity interaction. None of the changes to experiment two yielded significant results beyond those found in experiment one. In their third experiment the experimenters shifted the order of the terms (the major term, the middle term, and the minor term) in the logical syllogism in order to determine if the term had a significant effect on participants’ ability to avoid belief biases. Results indicate that there is no difference in the order of the presented terms, signifying that response-biases do not explain the validity of belief biases.

Markovits and Nantel (1989) investigated the relationship between logical competence and belief-bias with 186 French-speaking university students distributed into

four classes. Measures included a page of four multiple-choice logical reasoning questions and one of four student syllogism questionnaires: a positive production form, a neutral production form, a positive evaluation form, and a neutral evaluation form. In the positive evaluation form, participants were asked if a conclusion, derived from belief in the premises, could be valid from two stated premises that were assumed to be true. The neutral evaluation form was identical to the positive evaluation form, except that the minor premise from each syllogism was altered to make the conclusion neutral with respect to belief. The production forms were similar to the forms described above, with the exception that students needed to assess if a valid conclusion could be drawn from the premises and then produce the valid conclusion. The researchers found that scores were significantly higher for positive than neutral forms meaning that university-level educated participants' beliefs can affect the production of conclusions on tasks of logical reasoning. Furthermore, the researchers investigated participants' general abstract reasoning abilities and found that the belief bias effect existed independently of the participants' abstract reasoning abilities.

The hypothesis that working memory plays a critical role in the ability to overcome belief-biases is supported by developmental research. Handley, Capon, Beveridge, Dennis, and Evans (2004) investigated the relationship between belief bias, working memory, and inhibitory control with 61 school-age children (mean age 121 month). Measures included an inhibition task based on a visual cue, a logical reasoning task, and a working memory task consisting of a counting span. Results indicate that the accuracy on reasoning tasks with both arbitrary and belief-based context is highly correlated with working memory. Furthermore, Handley and colleagues (2004) demonstrated that the inhibition tied to working memory in the belief-based tasks is developmental and correlates significantly with an increase in age. Similarly, Kokis and colleagues (2002) found age-related trends in the ability of 108 middle

school students (fifth, sixth, and eighth grade) to solve deductive reasoning tasks where logic and belief are in conflict. Kokis and colleagues (2002) also found that deductive ability was also significantly correlated with other measures of analytic reasoning ability including inductive reasoning ability and probabilistic reasoning ability in this age group.

As part of the working memory investigation of belief biases, research has supported the hypothesis that the decline in working memory with age is correlated with the ability to correctly solve syllogisms with belief and validity in conflict. Gilinsky and Judd (1994) compared the performance of individuals of different ages in order to determine if there were age-related biasing factors that could account for an increase in biased responses. Participants were recruited from various professional, civic, and retirement-community organizations. Measures included a crystallized memory assessment, a believability assessment, and a syllogistic reasoning assessment. Results indicated that at every age, participants accepted conclusions that aligned with their beliefs. The experimenters found that when belief was consistent with logic, performance varied little across the life span. When belief was in conflict with logic, the experimenters found that performance declined greatly with age. Even when working memory was partialled out as a factor, participants were significantly better at solving valid-unbelievable syllogisms than on invalid-believable syllogisms. These results indicate that belief bias is a separable and critical component of age-related cognitive decline.

Several studies have investigated whether cognitive ability and thinking style can successfully predict the ability to overcome belief-biases in formal reasoning (Newstead, Handley, Harley, Wright, & Farrelly, 2004). If the belief bias effect occurs independently of a participant's abstract reasoning abilities, it is important to understand whether the belief bias effect would rely on the context of the argument or whether the belief bias effect occurs in

all domains when belief and logical syllogism are in conflict. Sá, West, and Stanovich (1999) investigated whether the belief bias effect was domain specific, whereby the belief bias effect would rely heavily on the contextualization of the argument, or if belief bias had a degree of domain generality, whereby a cognitive style hindered one's ability to recognize belief bias across tasks, with 124 university students in Canada. Measures included a syllogistic reasoning task, a perceptual judgment task, a cognitive decontextualization task (Raven matrices), a cognitive ability task (WAIS-R subtests), and an actively open-minded thinking questionnaire. The perceptual judgment task asked participants to judge photographs of heights of standing and seated males and females in a *matched* condition, where students were informed that the males and females matched in height, and were told not to use gender as a cue, and an *ecological* condition, where participants were informed that the photographs were reasonably representative samples of adults in North America. Results indicated that in a correlation between the estimates of heights and the target heights of the actual models, the means value of the ecological set was significantly higher than the matched set, meaning that prior beliefs had a significant effect on participants' judgments. Furthermore, in the ecological set, the researchers found that the participants had a tendency to overuse the gender cue. The results of the syllogistic reasoning task demonstrated an indication of significant belief bias on consistent items and the inconsistent items. The degree of belief bias on the syllogistic reasoning task correlated significantly with the degree of projection on the ecological sets, but not the matched sets of the perceptual judgment task. In a hierarchical regression analysis, only one measure was significant in the loading for prediction of avoidance of belief bias, the measure of actively open thinking. The extreme view that one's ability to evaluate evidence independently from domain to domain was proven to be false in this study. Belief bias had a degree of domain generality, whereby

participants that were more likely to avoid belief bias in judgment if they had a greater degree of actively open thinking, had greater cognitive ability, and were better able to differentiate belief bias in syllogistic reasoning tasks.

Torrens, Thompson, and Cramer (1999) suggest that the individual differences in the ability to overcome belief biases are due to the participant's ability to generate alternative hypotheses for the conclusion. In a study with 128 introductory university students, the researchers presented the participants with syllogisms (two premises) followed by four putative conclusions. As with previous research, a main effect was found for conclusion believability and conclusion validity, meaning participants accepted more believable conclusions than unbelievable and more valid conclusions than invalid conclusions. Unlike previous research, belief bias was not found to be significant for premise believability, meaning that conclusions accepted did not vary as a function of premise believability. The hypothesis that individual difference in the ability to overcome belief bias was correlated with the ability to generate alternative hypotheses was supported in this study, indicating that the greater number of alternatives generated by the participants was correlated with the ability to overcome the belief bias effect in reasoning. As with Markovits and Nantel's (1989) study, abstract deduction, abstract reasoning, and neutral logic was not correlated with the belief bias effect.

Prior Beliefs and Informal Logic

Several studies have tested measures that investigate the effect of prior opinions, beliefs, or attitudes on an informal argument (Greenhoot, Semb, Colombo, & Schreiber, 2004; Neuman, 2003; Neuman & Weizman, 2003; Nussbaum & Kardash, 2005; Stanovich & West, 1997), although few studies have specifically investigated attitude strength on informal

reasoning ability. Stanovich and West (1997) investigated the relationship between participants' prior beliefs about a series of propositions and participants' later evaluation of the quality of the same propositions for 349 undergraduate students recruited through an introductory psychology participant pool. Measures included an argument evaluation test, where students indicated their prior beliefs, followed by a degree of agreement with 23 target propositions, the self-reported verbal and math SAT scores, and a thinking dispositions questionnaire. Individuals varied significantly in their reliance of argument quality and prior belief when evaluating the provided arguments. The researchers split the two groups by median scores based on argument quality: a low argument quality group (LOARG) and a high argument quality group (HIARG). Although there was significant variability on the reliance of argument quality and prior belief when evaluating arguments, undergraduate participants with high argument quality were significantly more likely to evaluate arguments compared to an objective standard. Undergraduates who generated arguments of high quality were more likely to have openness in thinking disposition, and were less likely to rely on prior beliefs to evaluate arguments than individuals labeled as having low argument quality. Therefore, individuals who are able to generate high quality arguments do so more objectively, are more likely to consider alternatives to their position, and rely less on their own prior beliefs about an argument.

Neuman (2003) investigated high school students' ability to evaluate six informal logical fallacies with two examples from the following fallacies: the post hoc ergo propter hoc fallacy (false cause), the ad populum fallacy (appeal to the people), and the ad ignorantiam fallacy (appeal to ignorance) with 202 students from a regional secular high school in Israel. Prior opinions were assessed using a seven point Likert-type scale, which simply asked students to rate their agreement with statements concerning each of the

informal logical fallacies. For example, students were asked to rate their agreement on the statement “God exists,” and then evaluate an informal logical fallacy based on the statement. Although results indicated that prior opinion had no significant effect on five of the six fallacies, prior opinions considering the fallacy concerned with the topic of God was found to correlated with students’ ability to identify the ad ignorantium fallacy. Therefore, students who were more inclined to believe in the existence of God were significantly less likely to identify the ad ignorantium fallacy dealing with God. As stated by Neuman (2003), due to low cell frequency, it was not possible to control the God opinion statistically as a covariate. Neuman (2003) does not speculate as to the reason that prior opinion was significantly correlated with the inability to reject the informal reasoning fallacy relating to God, but one can hypothesize that the context of the argument, and the participants’ buy-in to this argument may have been significantly higher than the other arguments. The topics of the other fallacies concerned the acceptance of exceptional students into regular schools, intelligence and the use of computers, avoidance of paying taxes, the existence of UFOs, and childhood discipline relating to criminal activities.

Although prior beliefs have been shown to have an effect on one’s ability to generate and re-evaluate informal arguments, few studies have investigated prior beliefs, opinions, and attitudes on the acceptance of informal logical fallacies. Neuman and Weizman (2003) investigated whether prior opinions regarding an argument would influence a student’s ability to identify an informal reasoning fallacy with 58 ninth graders from two Israeli classes. Prior opinions towards an argument were rated on a seven point Likert-type scale. All tests of student’s prior opinion on the ability to identify a fallacy were found to be nonsignificant.

Greenhoot, Semb, Colombo, and Schreiber (2004) investigated the effect of participants’ prior beliefs and methodological concepts on the ability to scientifically reason

in different problem contexts with 419 students in an introductory child development course. Measures included two science exercises, a ball problem where students needed to predict how the speed of a ball would change due to the angle of a ramp's incline and the mass of the ball, and a television problem, where participants had to predict how much reading versus television watching would affect language development of children. The students' prior belief and methodological concepts - the function of evidence, reliability, objectivity, and experimental control were also assessed. Results indicated a main effect of prior beliefs on the evaluation of the two science exercises, meaning that students who held inaccurate prior beliefs were more likely than students with accurate beliefs to draw incorrect personal conclusions about the outcomes of the experiments. In contrast, when the same participants who drew incorrect personal opinions were asked to draw experimenter conclusions for a hypothetical experimenter, there was no significant difference between the inaccurate prior beliefs and accurate prior beliefs in the correct conclusions drawn for the hypothetical experimenter. The two methodological concepts of understanding the function of evidence and the concept of experimental control were significant predictors for student predictions for the hypothetical examiner. This study supports the hypothesis that students reason differently when drawing accurate conclusions about *abstract* principles, versus drawing accurate conclusions *for themselves*, specifically in cases where data contradicts prior beliefs about a phenomenon.

Nussbaum and Kardash (2005) investigated ways to increase 184 undergraduate participants' examples of counterarguments when writing argumentative texts. Previous research on school children demonstrated that providing middle school students with specific goals in argumentation (e.g., generate reasons, counterarguments, and rebuttals) led to an increasing number of argument elements than providing the students with a general

goal (form a persuasive argument) (Ferretti, MacArthur, & Dowdy, 2000). Nussbaum and Kardash (2005) attempted to replicate the results of Ferretti and colleagues (2000) in their first study with university students in conjunction with a measure of prior beliefs. Measures included an essay prompt with one of three different conditions: a control condition, where students were asked to express an opinion regarding a prompt, a reason condition, where students were asked to explicitly provide reasons to support the position, and a counterargue/rebuttal condition, where students were asked to provide reasons to justify their position and then provide two or three reasons why other may disagree with the position. Measures also included an attitude survey assessing prior attitudes towards the prompt. As hypothesized, an interaction with prior attitude and primary claim and prior attitude and supporting reason were found signifying that myside biases played a significant role in the development of an argument. The counterargument/rebuttal condition decreased the number of primary claims for students with extreme prior attitudes. Furthermore, the number of spontaneously generated counterarguments was rather low, or less than one argument per essay, and only a small fraction of these were rebuttals in the control condition. Therefore, prior attitudes have a significant impact on the generation of arguments and on the generation of support for arguments.

In a follow-up study, Nussbaum and Kardash (2005) investigated the myside biases that would occur using two conditions following a persuasion condition and a no-persuasion condition and a text and a no-text condition with 77 undergraduate students. In the persuasion condition, the participants were instructed to write a paragraph designed to persuade a representative, while the no-persuasion condition asked for the participant's opinion on a prompt. In the text condition, the students were provided with a brief paragraph outlining numerous arguments on both sides of the issue. Results confirmed that

the persuasion goal decreased the number of counterarguments, confirming the belief that raising counterarguments reduces overall persuasiveness. Results of the text condition confirmed that presenting students with counterarguments led to a significant increase in the production of counterarguments over the control group, but only when the students were in the no-persuade group. These results confirm that both belief bias and the persuasion condition can significantly impact the production of counterarguments.

Developmental Trends in Critical Thinking and Argumentation

Research has been dedicated to the development of critical thinking and argumentative skills with children, adolescents and adults. Klaczynski (2000) investigated the effects of adolescents' reasoning biases on theories of social classes and theories of religious affiliation using the ability to apply the "law of large numbers" (LLN) with 31 early adolescents and 35 middle adolescents spread over two testing sessions. The law of large numbers is "the statistical precept that the certainty of an inference about a population increases as the size of evidential samples drawn from that population increases" (p. 1351). Measures included nine experiment-evaluation problems and twelve LLN problems for the social class condition and the religion condition (three problems favorable to the condition, three problems unfavorable to the condition, and six problems neutral to the condition), a theoretical belief questionnaire, and three measures assessing epistemological disposition. Participants evaluated the strength of the conclusions in each condition and wrote a justification of why they believed each statement was valid or invalid. Results for the social class condition indicated that middle adolescents rated the experiment evaluation problems as weaker and less reliable than the early adolescents and were able to provide more justification for their responses. The justifications for both age groups were more complex

for the unfavorable social condition, than both the neutral and favorable conditions. Results of the LLN condition showed that middle adolescents rated the arguments as weaker and less persuasive than early adolescents. Middle adolescents also had higher justification scores and justifications were more complex for unfavorable and favorable conditions than neutral conditions. Middle adolescents also made more implausibility claims on unfavorable problems than on neutral or favorable problems. Several conclusions can be drawn from this study. Whereas middle adolescents typically show a greater competence for scientific reasoning than early adolescents, in-group favoritism was still exhibited by members of both age groups. These biases are indicated by higher ratings, fewer scientific justifications, and fewer implausibility responses for ones own-religion favorable problems.

Perkins (1985) assessed the ability of 320 participants (high school freshmen to doctoral level students) to provide a position and supporting argument for a topic concerning a public issue. Measures included an interview with one of the investigators where participants were to reason about an issue and provide follow-up responses to the investigators, and a cognitive assessment measure. Responses were tape recorded and assessed on the number of sentences provided, the lines of argument, the number of objections raised, the number of prompts provided by the investigators, the ability to explain the reasoning provided, and an overall rating of the argument. Results indicated that, according to the investigators, none of the students appeared especially competent at informal reasoning. The amount of education seemed to have a borderline significant impact on the number of lines of arguments provided (graduate students = 3.3 line of arguments, while high school freshmen = 1.8 lines of argument). Although the researcher considered these very modest reasoning gains for education, or approximately a tenth of a line of argument per year, the greatest gain for the number of sentences occurred in high school

(approximately .4 sentences per year). Perkins (1985) suggested that the development of informal reasoning had a strong expert-novice contrast in construction.

Epistemological Understanding

Several studies have shown that epistemological factors influence one's ability to reason logically. Epistemology is the study of what people believe about the acquisition of knowledge, how it occurs, what is accomplished, and how it operates in their lives (Kuhn, Cheney & Weinstock, 2000). Knowledge and belief can be distinguished in two ways. First, a belief may be false, and second a belief may be based on insufficient evidence (Kardash & Scholes, 1996). Epistemological level has been shown to underlie informal reasoning ability. In their first study, Kuhn, Cheney, and Weinstock (2000) investigated the effect of transitioning between epistemological levels on the domain context of an argument presented with a developmentally diverse group of participants (20 fifth graders, 25 eighth graders, 20 undergraduate students at a highly selective university, 20 enrolled in a vocational public community college, 18 business executives, and 5 Ph.D. candidates in educational philosophy). Measures consisted of fifteen contrasting statement items presenting judgments within hypothesized developmental domains (aesthetic domain, value domain, social truth domain, physical truth domain) followed by two questions (the second contingent on the first question response) addressing the transition from different epistemological levels. The transitional levels addressed in this study were the absolutist to multiplist or multiplist to evaluativist epistemological level. Results indicated that differences across age groups were modest. Using the number of nonabsolutist responses as the dependent variable, the comparison between all adults to all participants was significant in the transition from absolutist to multiplist, but not the transition from multiplist to evaluativist. With respect to

the younger group in the first transition, the difference between the eighth graders and the undergraduates was found to be marginally significant. Significant differences were found between the undergraduates and fifth graders, and the undergraduates and twelfth graders, representing epistemological shifts.

In their second study, Kuhn, Cheney, and Weinstock (2000) investigated why few transitions between the absolutist and multiplist epistemological levels were present in the first study. In individual verbal interviews with twenty-one second and third graders, the experimenters completed a task containing fifteen contrasting statements with the students. Results indicated that eight of the twenty-one children interviews showed the transitional pattern between absolutist and multiplist levels. All but two participants recognized that people could legitimately have different personal tastes. These findings support the hypothesis that the transition between levels occurs rapidly once it begins to develop, and that epistemological level can have a direct influence on the evaluation of truth judgments.

Kardash and Scholes (1996) have demonstrated that preexisting beliefs bias the retrieval of information in favor of information consistent with current beliefs. Undergraduates were examined to understand how the influence of general beliefs about the certainty of knowledge, the strength of their beliefs towards a topic, and their tendency to engage in effortful thinking affected their evaluation of conflicting evidence on a the controversial issue of the HIV virus causing AIDS. In their first study, 96 participants read a text concerning alternative viewpoints on the cause of AIDS and completed an epistemological questionnaire, a survey on their beliefs about AIDS, a Need for Cognition scale, a test of verbal ability (WRAT), and a conclusion task about the cause of AIDS. Results indicated that participants' factor scores on certainty of knowledge and their prior beliefs about the cause of AIDS were significantly correlated with the degree of written

certainty in their conclusions. Consistent with previous research, the investigators found that epistemological factors were not correlated with each other, meaning that epistemology is the composite of relatively independent beliefs. Furthermore, results revealed a significant correlation between the participants' belief in the certainty of knowledge and the extremity of their initial beliefs about the HIV-AIDS relationship. Individuals who held a lower belief in the certainty of knowledge also enjoyed engaging in challenging cognitive tasks, were more likely to write conclusions that reflected the inconclusiveness of the argument, and held a tentative nature about the mixed evidence they read. This study demonstrates the importance of epistemology in the ability to critically evaluate arguments, and demonstrates that prior beliefs can lead to biased conclusions regarding conflicting evidence in evaluations of social topics. This research provides additional support for belief biases and may provide an explanation why some individuals fail to critically evaluate arguments.

Weinstock & Cronin (2002) examined the relationship between epistemological understanding, the skill of juror reasoning, and the basic skills of argument with 181 people in a jury pool (91 males and 89 females ranging in age from 19 to 73). Self-report of participant education levels showed 40% with no education beyond high school, 25% with some college, 21% with a bachelor's degree, and 14% having had some graduate or professional school experience. Although the researchers hypothesized that education would predict overall epistemological level, education seemed to be a fairly weak predictor of one's ability to informally reason (Means and Voss, 1996; Perkins, 1985). Measures included an epistemic reasoning task, where participants were asked to evaluate the two discrepant historical accounts, and a juror reasoning task, where participants were interviewed for use of evidence, the ability to discount alternative verdict choices, the ability to generate counterarguments against verdict choice, the ability to offer explanations of other's

alternative verdicts, and the degree of certainty about the verdict choice. Results indicated that epistemological level was found to predict almost every juror-reasoning dimension. Therefore, the researchers concluded that “epistemological level, through its effect of performance in skills of argument, influence overall argument ability” (p.177). The findings support the general hypothesis that epistemological level underlies general argument ability.

Informal Reasoning Fallacies

Only within the past several years have psychologists begun to investigate individuals’ ability to reject informal reasoning fallacies (Ricco, 2007). The number of informal fallacies that exist varies from source to source, considering some fallacies are subheadings of other fallacies (e.g., a red-herring fallacy may be seen as a subset of the straw person fallacy). Although over twenty unique fallacies have been identified (Copi & Burgess-Jackson, 1996), the psychological literature has focused on about ten of these fallacies. The ability to reject informal reasoning fallacies and furthermore, to explicitly identify the fallacy, has been the subject of several studies (Oaksford & Hahn, 2004; Neuman, 2003, Neuman, Glasner, & Weinstock, 2004; Neuman & Weizman, 2003; Neuman, Weinstock, & Glasner, 2006; Ricco, 2003; Ricco, 2007; Weinstock, Neuman, & Tabak, 2004; Weinstock, Neuman, & Glasner, 2006).

Research has demonstrated that factors outside of identifying the structure or recognizing the form of the informal reasoning fallacy argument can affect participant acceptance of a fallacy. Specifically, researchers have investigated whether students’ comprehension of text material has an effect on the acceptance of written fallacies. Neuman (2003) investigated high school students’ ability to deal with the post hoc ergo propter hoc fallacy (false cause), the ad populum fallacy (appeal to the people), and the ad ignorantiam

fallacy (appeal to ignorance) with 202 students from a regional secular high school in Israel. Measures included six informal reasoning tasks whereby students were evaluated for whether they were able to identify a fallacy, to explicitly express the fallacy, to resist responding with a fallacy, provide a justification of their response, and provide a planning question following the fallacy. The students were also administered a text comprehension task, an opinions' item sheet, and a logical reasoning task. Neuman (2003) found that the ability of the students to comprehend a text significantly predicted students' ability to identify four of the six fallacies.

In a follow-up study to Neuman's (2003) study assessing individuals ability to comprehend text as a factor in the recognition of informal reasoning fallacies, Neuman and Weizman (2003) investigated the effect of students' ability to encode the deep structure of an argument task on their ability to identify an informal logical fallacy with 58 ninth grade students in a secular urban Israeli high school. Measures included the informal reasoning fallacies identification task (the false cause fallacy, the fallacy ad populum, and the fallacy ad ignorantiam), a recall task, and an opinion items sheet to assess prior beliefs of students regarding the subject of the fallacies. In their first experiment, students were asked to listen to six different audio-taped argument scenarios, with a reading time of 45 seconds for each scenario and a 5 second gap of silence between each scenario. Results indicated that the association between student performance on the recognition task and the identification questions was non-significant. Students who scored higher in the recall portion of the task (the ability to recall the fallacy) had better representation of the text than students who only recalled the surface structure of the text. The number of situations where the students could identify the fallacy was significantly correlated with the number of situations where the students could identify the deep structure of the situation. Furthermore, the correlation

between the surface structure recall and the number of situations where the students could identify the fallacy were also significantly correlated. This result suggests that students who were able to identify the fallacy were more adept at recalling both the deep and surface structures of the argument. In their second experiment, Neuman and Weizman (2003) replaced the argument recall task with a classification task, and replaced the false cause fallacy with the ad hominem fallacy. Fifty-three Hebrew speaking ninth graders from a different regional secular high school participated in this experiment. In the classification task, the participants received 18 short scenarios and were asked to classify them in groups where stories were similar to each other. The researchers counted the number of groups where the scenarios shared the same fallacy, but differed in surface structure. Students who classified at least one group according to a fallacy were considered “good solvers.” When students were asked to first solve the classification task and then the identification task, 21% of students were good solvers. In contrast, when the identification task was presented first, 53% of students were good solvers. The correlation between fallacy identification and good solver classification was found to be statistically significant. Good solvers classified fewer samples according to their surface structure elements over both conditions, for the identification-classification condition, and the classification-identification condition. This study emphasizes the importance of representing the argument, in general, in terms of the deep structure and the identification of the logical fallacy, in particular in high school students.

The research regarding participants’ prior beliefs and attitudes on the topic of the informal reasoning fallacy is mixed. Prior opinions on the topic of God were found to correlate with students’ ability to identify the fallacy (Neuman, 2003). Therefore, students who were more inclined to believe in the existence of God were less likely to identify the ad

ignorantium fallacy. In Neuman (2003) the prior opinions on the five other topics investigated included the existence of UFOs, the acceptance of exceptional students in mainstream classes, the paying of taxes, the instruction of students using computers, and the discipline of children, and did not show a prior belief biasing effect. Neuman and Weizman (2003) found that the influence of prior opinions on students' ability to identify the fallacy was found to be non-significant when assessing for the deep or surface structure of the text. Neuman, Glasner, and Weinstock (2004) asked participants to rate how much they agreed with the protagonist's view in a scenario on a seven point Likert-type scale. Neuman, Glasner, and Weinstock (2004) failed to report if the participants' agreement with the protagonist had an effect on the evaluation of the informal argument.

Additional evidence supports the hypothesis that factors outside of recognition of an informal fallacy can affect acceptance of the fallacy. Neuman, Glasner, & Weinstock (2004) investigated the relationship between a reason's truth-value and the judgment of a fallacious argument in 77 eleventh graders from three classes in a high school program. The researchers hypothesized that students might be influenced by the truth-value of evidence, even when the truth-value is irrelevant to the soundness of the argument. Using a variation of Neuman and Weizman's (2003) informal reasoning task, participants completed the informal reasoning tasks, an opinion item sheet, and an argumentation norms task. Students were shown to hold appropriate argumentative norms when in the argumentation norm task they rejected 96% of *ad populum* fallacies, 85% of arguments *ad ignorantum*, and 99% of arguments *ad hominem*. When randomly assigned to different conditions, students were significantly more likely to accept a fallacious argument when a claim was purported as true than when a claim was purported as false. Students' judgment between the inconclusive statement and the false statement were also found to be significant. Therefore, students are

more likely to judge a fallacious argument as valid when the argument conclusions are presented as true than when conclusions are presented as false. This research investigates only three of the informal logical fallacies that can occur in argumentation. Additional research is necessary in order to determine if a reason's truth-value, or when participants are told an argument is true or false, affects all fallacious arguments equally.

Ricco (2007) investigated the influence of argumentation norms, personal epistemology, and deductive reasoning on the ability to effectively analyze six informal reasoning fallacies with 112 working-class students attending psychology classes at a university in Southern California. The participants in this study were primarily female ($n = 100$; 89%), juniors or seniors ($n = 92$; 82%), and Hispanic ($n = 42$; 38%). Measures included an informal fallacy task, a syllogism (deductive reasoning) task, an argumentation norms task, an epistemological beliefs questionnaire, a source of knowledge scale, and an attitudes toward thinking and learning scale, each adapted from previous research. The researcher found that the degree of difficulty of the logical fallacy was correlated with the ability to logically deduce reasoning from the argument. Student performance in logic-belief tasks of consistent syllogisms was significantly better than performance on both inconsistent 1 syllogisms ($M = .49$; $SD = .25$), where logic and belief were in conflict, and inconsistent 2 syllogisms ($M = .50$; $SD = .24$), where logic and belief were in conflict but there is also a manipulation of the complexity of the argument. Preferred and non-preferred conditions in the inconsistent 2 syllogisms did not vary significantly. The researcher also found that participants who were more familiar with critical discussion norms and formal debate norms were significantly more likely to identify, explain, and provide a strict explanation of informal reasoning fallacies than individuals familiar with only critical discussion norms or formal debate norms. The research found that more complex epistemological beliefs and more

sophisticated positions with regard to learning were associated with the ability to reason about a fallacious argument. Specifically for personal epistemology, speed of learning, the structure of knowledge, the attainability of truth, and the source of knowledge were significantly and positively correlated with the identification and strict explanation of a logical fallacy. Also for personal epistemology, speed of learning, the structure of knowledge, knowledge construction, the attainability of truth, and the source of knowledge were significantly and positively correlated with one's ability to provide an explanation for an informal logical fallacy. The researcher found that GPA correlated significantly with informal fallacy task performance when income and parent education were controlled, but neither income nor parent education was related to performance when GPA was controlled. In a regression analysis, controlling for GPA, the researcher found that deductive reasoning, pragmatic knowledge, and personal epistemology provide a combination of factors that produce the ability to identify and explain informal logical fallacies. Limitations of this study include the non-systematic fashion of the norms assessed across fallacies. The researcher found that individuals who are more familiar with critical discussion and formal debate norms, and individuals with more complex epistemological beliefs, were more likely to identify, explain, and provide a strict explanation of informal reasoning fallacies.

The research regarding the ability of individuals to identify informal reasoning fallacies is currently mixed as to the correlation of individual's ability to identify deductive reasoning fallacies. Some research has supported that idea the performance on informal reasoning fallacies correlates with one's ability to identify formal reasoning fallacies (Ricco, 2007), while other studies have failed to demonstrate this correlation (Ricco, 2003; Neuman, 2004).

Weinstock, Neuman, and Tabak (2004) investigated whether students' familiarity with argumentation norms affected their ability to identify informal reasoning fallacies with 281 students from an Israeli heterogeneous urban school. Measures included an informal reasoning fallacy identification task, where students were asked to identify a problem within three informal reasoning fallacies grouped into six arguments (two arguments per fallacy). The students were asked if they could explicitly state the problem, and then asked to choose from a forced choice argumentation classification question, and an argumentation norms task, where students were asked if argumentation were legitimately used to persuade. Results indicated that across all scenarios, students were better able to identify a problem within the argument than explicitly state the problem (Identification = 62%, Explicit = 38%). Students who were aware of the argumentative norms performed better on the identification measure than those who were not. Individuals who performed better in the test of argumentation norms were found to identify the fallacy significantly more often for all three fallacies in each of the six scenarios. The test was significant for the ad populum fallacy: exceptional students and drugs; the ad hominem scenarios: tax and alien; and the ad ignorantiam scenarios: UFO and weapons. This study provides evidence that high school students with familiarity with argumentation norms were better able to identify three informal reasoning fallacies in high school age groups. Limitations to this study were the fact that many of the scenarios may not have been directly relevant or familiar to the students. Furthermore, of the numerous informal reasoning fallacies, this study's scope only included three of the popular fallacies.

Neuman, Weinstock, and Glasner (2006) investigated the effect of the presentation context of an argument on the ability to judge fallacious informal reasoning with 71 eleventh grade students. In the first experiment, the participants were asked to identify fallacious arguments supported by differing amounts of argument contexts (i.e., was the argument a

quarrel or debate) and then to distinguish the different contexts. Measures included a variation of Neuman and Weizman's (2003) informal reasoning task, whereby participants were asked to reason based on three informal reasoning fallacies: the argument ad populum (appeal to people), the argument ad hominem (argument to the person), and the argument ad ignorantiam (argument from ignorance). The participants were divided into three groups; one containing just the argument identification task, one containing two questions asking how the argument helps to achieve the *goal* of the arguer and the *claim* of the argument, and the third containing an open-ended question asking how the student would counter the argument. Results indicated that there were no significant differences in participants' ratings to the extent that a logically fallacious argument helped support the claim across contexts. The participants did rate that the argument was more effective in furthering the goal of the argument in nonreasoned arguments over reasoned arguments. Although participants were sensitive to the context, recognizing the fact that the argument did not support the claim, the participants rated that the arguments may still have supported the arguer's goal.

In their second experiment, Neuman, Weinstock, and Glasner (2006) examined the convincingness of informal reasoning arguments in the context of a reasoned argument, with participants in either the claim proponent role or the adversary role. The participants for this study were 52 twelfth grade students from a regional secular high school. In this study, the measures included the informal reasoning fallacies identification task with four types of informal fallacies: the argument ad hominem, the argument ad populum, the argument ad ignorantiam, and the post hoc ergo propter hoc fallacy (the false cause fallacy). In half of the scenarios, the participants were instructed to take the proponent's perspective in the argument, while in the other half the participants were told to take the adversarial perspective. Results indicated that participants' ratings of the quality of the argument were

significantly higher for situations where they were instructed to take the proponent's position over the adversarial position. This research supports the hypothesis that students can differentiate between the effectiveness of an argument based on context, but that students have a more difficult time differentiating fallacious arguments when asked to support the informal argument.

Differentiating Explanations and Evidence in Informal Reasoning

Research has shown that individuals can have a difficult time differentiating evidence and explanations in informal arguments. Participants who do not understand the nature of the informal reasoning task, or the subtleties in the argumentation form may lead participants to have a difficult time recognizing informal arguments. Kuhn (1991) found that the majority of individuals, when asked to justify their position on casual theories, do not make an adequate appraisal of the strength of their argument. Specifically, individuals were as likely to provide non-evidence or pseudoevidence, as they were to provide genuine evidence for their claim.

Brem and Rips (2000), found a similar phenomenon when they investigated the ability of twenty participants (each with at least two years of college experience) to distinguish between evidence-based responses and explanation-based responses on common social problem scenarios. The researchers hypothesized that participants' ability to provide genuine evidence for an argument was affected by the participants' presence or lack of relevant data on which to base the argument. Therefore, participants who were asked to give their best supporting evidence (whether factual or not) in unfamiliar scenarios would be more likely to give genuine evidence-based responses than participants who were asked to convince someone with evidence from previous knowledge. The participants were separated

into two groups: an actual condition, where participants were asked the specific wording from Kuhn's (1991) study, "If you were trying to convince someone your view is right, what evidence would you give to try to show this?" which the researchers believed would suggest that participants base explanations on previous knowledge, and an ideal condition, where participants were asked to imagine the strongest supporting evidence one could provide, whether factual or not. Measures for this study included a booklet of sixteen social issues. Participants were asked explain what they believed to be the cause of the problem in each issue, rate their familiarity with each social issue, and rate the strength of their evidence for each issue. Participants were scored by two raters who were blind to the participant's condition, and who used the same categories as Kuhn (1991): *genuine evidence*, *pseudoevidence*, or *other*. The researchers found that, in line with their predictions, participants in the ideal condition, who were not bound by previous knowledge, gave significantly more evidence-based responses. Participants did not vary significantly on their familiarity with the scenarios or on their ratings of the strength of their arguments.

In their second study, Brem and Rips (2000) hypothesized that participants would be more likely to support explanation claims instead of evidence when the participants believed that information was scarce. The 44 participants were separated into two equal groups: an *information rich* condition and an *information poor* condition. Although both groups received the same amount of information prior to the study, the *information rich* condition was led to believe that they had a rich body of evidence available, while the *information poor* condition believed they had very little evidence in support of the claims. The second factor, *Support type*, had participants rate, on a seven-point scale, how well either an explanation or correlational evidence supported each claim. Results from this study showed that participants show a preference for evidence in both information poor and information rich

conditions, but that explanations rise significantly when participants believe that information is scarce.

In their third experiment, Brem and Rips (2000), investigated whether alternative hypotheses for explaining of a claim induced participants to demand more or stronger support, or would make participants willing to commit to a single claim. In this study, 63 college students participated in one of two groups: *information rich* or *information poor* levels, which were between-participant variables. Half of the participants in each group were provided with a position on an issue, while the other half were asked to provide their own position. Participants in the Opinion group, or those asked to provide their own position, were asked on a seven-point scale how much their own opinion conformed to a given opinion before providing evidence to their opinion. Results indicated that information rich participants referred to evidence twice as often as information poor participants and the difference was significant. In an examination of the Opinion source, the conformity ratings did not indicate any effect of unintentional correspondence between or divergence from participants' own beliefs. Participants who were given opinions referred to evidence on 40.3% of the trials, whereas participants who gave their own opinion referred to evidence on 25.8% of trials. The interaction between opinion source and information suggests a stronger effect for the information poor condition.

In their fourth experiment, Brem and Rips (2000) had participants classify the support provided in a presented argument and then to comment on the support. Twelve undergraduate students participated in this experiment using the stimuli in Experiment 2 and answering three additional questions regarding (1) whether the speaker provided an explanation or evidence to support their opinion, (2) if the speaker provided one of the two conditions (explanation or evidence), should the speaker have provided the other instead,

and (3) if the speaker provided one condition, why did the participant believe that the speaker did not provide the other condition? Results indicated that participants correctly classified explanations and evidence 73.8% of the time. The most common error (14.6%) was labeling the items as both explanation and evidence, whereby participants were able to provide rationale for their identification. In 91.2% of responses, the participants believed that evidence-based support was appropriate. Evidence-based support was labeled as unsatisfactory in 50% of responses, while 29% stated that explanations alone were sufficient. The researchers have found that participants' difficulty with defining explanation and evidence needs qualifications. In some cases, confusion may arise from pragmatic factors within the argument that surround generating, presenting, and evaluating claims. Although there is individual difference on the reliance of evidence, participants are more likely to use explanations when little evidence was available.

Sá, Kelley, Ho, and Stanovich (2005) assessed the individual differences involving the coordination of theory and evidence with 96 mature students (mean age was 32.0 years, SD = 9.4) in an informal reasoning task. Measures included a theory/evidence interview, where participants were asked a causal theory question and then asked for evidence to support the participants' claims. The participants also completed a cognitive ability measure, a thinking disposition questionnaire, a scale to assess open-minded thinking, and a superstitious thinking scale. The researchers distinguished between sophisticated reasoning, or participants who provided a covariation comparison, and unsophisticated reasoning as reiteration or elaboration. Results indicated that both high and low cognitive ability groups were likely to use unsophisticated evidence when asked to provide evidence for a previously stated theory. The unsophisticated reasoning also correlated positively with the measure of superstitious thinking. As found with previous studies (Stanovich & West, 2007; Stanovich & West,

2008(1); Stanovich & West, 2008(2); Toplak & Stanovich, 2003), cognitive ability failed to predict reasoning ability. Furthermore, consistent with Brem and Rips (2000), individuals failed to correctly differentiate between explanations and evidence. The ability to decontextualize (i.e., decoupling evidence from theory) was found to significantly correlate with cognitive ability and the two thinking disposition scales. The cognitive style that reflected open-minded thinking and the ability to avoid unsophisticated reasoning reflected a different cognitive ability than was measured on the standardized cognitive assessment (Raven Progressive Matrices).

The Biasing Effect of Motivated Reasoning

The general view of motivated reasoning refers to individuals being less skeptical consumers of desirable than of undesirable information (Ditto & Lopez, 1992). More specifically, motivated reasoning bias manifests when individuals judge a conclusion as more valid when it aligns with belief-consistent information than when it aligns with belief-inconsistent information. Ditto and Lopez (1992) investigated whether individuals would use differential decision criteria for preference-consistent and preference-inconsistent conclusions with 67 female undergraduates from Kent State University. Specifically, the investigators were interested in the determining whether individuals would need the same amount of information to make a conclusive decision about preference-consistent and preference-inconsistent tasks. Results indicated that participants used different criteria for preferred and non-preferred judgment conclusions. Participants who received preference-inconsistent evidence about a hypothetical contestant believed he was less intelligent, and participants needed less information to arrive at this conclusion. A similar pattern did not occur when the participants believed the contestants were likeable. The participants reported

an equal amount of surprise when both groups, the preferred and non-preferred participants, found that the contestant performed poorer than expected. In their second study, Ditto and Lopez (1992) told one group of participants that the lack of color change in a fake enzyme strip did not indicate an enzyme deficiency, and told a second group that the lack of color change indicated an enzyme deficiency. The participants in the negative group, lack of color change did indicate a deficiency, spent significantly more time testing the strip for a color change, took significantly longer to arrive at a conclusion, downplayed the significance of the test, and stated that the accuracy of the test was less than those in the preferred condition. In the third experiment, Ditto and Lopez (1992) provided reasons why the accuracy of the enzyme strip may have been affected, such as irregularities in sleep, diet, and stress patterns. Participants in the non-preferred conditions endorsed significantly more reasons and generated more hypotheses for the test being inaccurate.

Prior Beliefs and Attitude Strength

In their classic study, Lord, Ross, and Lepper (1979) asked 151 undergraduate students to complete a questionnaire on the social issue of capital punishment and then provided the participants with both confirming and disconfirming evidence for their prior held beliefs and attitudes toward capital punishment. Following the presentation of both confirming and disconfirming evidence, the participants were asked about their change in attitude towards capital punishment and were asked about the convincingness of the empirical evidence and findings by circling their degree of belief on a Likert-type scale. Results confirmed the experimenters' polarization hypothesis, where following the examples, proponents were significantly *more* in favor of capital punishment, while opponents were significantly *less* in favor of capital punishment. Proponents also reported significantly greater

belief in the deterrent effect of capital punishment, while opponents reported significantly less belief in this effect. Final attitudes towards capital punishment and beliefs concerning the deterrent efficacy of were also highly correlated. Finally, the experimenters noted that the participants' attitude across time was subject to be momentarily swayed when belief inconsistent evidence was presented first and attitudes were assessed immediately following the presentation of the evidence. This effect disappeared in a "rebound effect" immediately after belief-confirming evidence was presented to the participants, and in some cases led to an even more extreme position. This study provides data that belief-confirming evidence will be more readily accepted than belief-disconfirming evidence and furthermore, that belief polarization will *increase*, rather than decrease or remain static, when mixed or inconclusive findings are incorporated into an participant's opposite viewpoints.

Krosnick, and colleagues (1993) investigated ten possible dimensions of attitude strength (extremity, intensity, certainty, importance, interest in relevant information, knowledge, accessibility, direct experience, latitudes of rejection and noncommitment, and affective-cognitive consistency), in order to determine how strong attitudes could be distinguished from weak ones. A similar feature of the ten possible dimensions of attitude strength investigated by Krosnick and colleagues (1993) were four aspects of strength: persistence, resistance, impact on cognition, and impact on behavior. One possible reason for each of these ten dimensions sharing the aspects of strength is that the dimensions may have reflected a single underlying construct. Another possible reason for these dimensions being correlated with the aspects of strength may be that they closely related as a system. Therefore, a high level in one dimension "activates" various cognitive and behavioral processes that elevate the other dimensions. Using a multitrait-multimethod approach, Krosnick and colleagues (1993) measured each dimension using the operationalizations used

in previous attitude strength research to create a structural equation model of attitude strength. Participants were 288 undergraduates who were randomly assigned to answer questions based on either abortion or capital punishment. Results indicated that a single-factor model was significantly worse at predicting attitude strength than allowing all of the substantive factors to correlate freely with one another (called the *saturated model* by the researchers). Therefore, the results suggested that a single-factor model should be rejected for attitude strength. In a second study, Krosnick and colleagues (1993) used alternative techniques, instead of self-reports, to measure knowledge and accessibility. The researchers also changed the topic of argument (defense spending). Results were identical to the first experiment, where a saturated model better accounted for the overall fit than an underlying construct. Since the ordering of the constructs was identical in the first two experiments, the researchers conducted a third experiment to control for the consistency pressures during questionnaire completion. Results indicated that the rank ordering of questions had no effect on the participants' responses. Furthermore, the single-factor model was again rejected in the third experiment. The researchers stated that a single attitude strength construct was not supported by their evidence, and concluded that each of the dimensions measured were distinct, but in most cases related to one another.

Haddock, Rothman, and Schwarz (1996) provide two hypotheses of how the strength of an attitude is determined. First, when attitudes are highly accessible, individuals may claim that they hold a strong attitude. If accessibility is the underlying cause of attitude strength, the researchers suggested that individuals should be able to generate multiple arguments supporting their attitudes. The research also suggested that lower attitude strength should be supported when participants are asked to think of counterarguments for their claim. Secondly, attitude strength may be affected by subjective experiences that accompany

the generation of the argument. As opposed to the high accessibility hypothesis of attitude strength, individuals may be able to generate few supporting arguments for their claim, but they should also be able to generate a similar number of negating arguments, which do not affect their attitude strength. In order to test these hypotheses, the researchers asked sixty undergraduate participants to generate three (easy) or seven (difficult) reasons that either supported or countered a socially debatable position (physician-assisted suicide). The researchers investigated five dimensions of attitude strength, three of which were subjective judgments (attitude importance, intensity, and certainty), and two of which were cognitive structure dimensions (frequency, knowledge). Results indicated that participants had a significantly easier time generating three, as compared to seven arguments. No other effects were found to be significant. Participants rated their last arguments when asked to generate seven arguments as equally convincing as participants who were asked to evaluate their last arguments in the three-argument condition. Judgments of importance, intensity, and certainty were found to have a significant interaction with the convincingness of the argument. The cognitive structure of frequency and knowledge were unaffected by the researchers' manipulation. Therefore, reports of subjective judgment of attitude strength varied as a function of the ease of argument generation.

In assessing attitude strength, it is important to note whether the measures affect extreme and mild attitudes in the same way. Haddock, Rothman, Reber, and Schwarz (1999) followed up their previous study (Haddock et al., 1996) in order to show that effect of the relative ease that attitude-relevant information comes to mind on people's perceptions of their own attitudes. The researchers emphasized that since individuals typically do not have ready-made assessments of their attitude strengths, subjective beliefs and reports of attitude strength may vary as a function of the context in which the judgment is provided. In their

first study, Haddock and colleagues (1999) investigated the subjective experiences on judgment as a function of the extremity of an individual's attitude with eighty students from an introductory psychology pool. Participants were selected based upon their responses on a previously administered attitude scale, where respondents were either very much in favor of or against the issue of doctor-assisted suicide. Following the previous study (Haddock et al., 1996), participants were asked to provide three (or seven) arguments in favor (or against) the topic of doctor-assisted suicide. The results found that participants had an easier time generating three as compared to seven arguments and that participants had an easier time generating supporting arguments than counterarguments. A main effect of prior attitude was found for the composite judgments of attitude strength, and also for each of the dimensions independently (attitude certainty, intensity, and importance). Therefore, the results confirmed the hypothesis that accessibility only affected the subjective reports of attitude strength for individuals with moderate attitudes. Participants with extreme prior attitudes were not affected by accessibility experiences.

In their second experiment, Haddock and colleagues (1999) investigated the role of accessibility experiences as a mediator of attitude strength with 78 undergraduate students from an introductory psychology class. Using the misattribution paradigm, the researchers informed participants that music played during the reasoning task would facilitate (or inhibit) recall on attitudes of doctor-assisted suicide. Results indicated that participants found it significantly easier to generate three arguments as compared to seven arguments. Participants in the diagnostic group, or those told that the music would facilitate recall, relied on this information when deriving their judgments as to whether the arguments were convincing. Only when participants experienced their subjective experiences as diagnostic, or facilitating recall, were their attitudes considered as a source of information.

Prior to investigating the attitude strength of an individual, it is important to assess whether the form of the question addressing the topic can have an effect on the participant's attitudes towards a topic. According to Henderson, de Liver, and Gollwitzer (2008), the impact of an attitude on an individual's response towards objects depends on two properties: attitude strength and attitude content. Attitude strength refers to the overall attitude persistence over time, influence on cognition, resistance to change, and regulation of behavior. Attitude content refers to the overall evaluation (positive or negative) of some attitude object. The investigators were interested in how mind-set may affect a person's attitude. Mind-set theory "postulates that the unique tasks associated with the different action phases of goal pursuit lead to the activation of appropriate cognitive procedures or mind-sets" (Henderson et al., 2008, p.397). For example, when thinking about an object (e.g., vacation), how individuals think about the object can affect available information: implemental (e.g., How will I plan my vacation?) versus a deliberate choice (e.g., Should I go on a vacation or not?; p. 397). The researchers investigated whether implemental mind-set participants were more likely to adopt an extreme position on a topic than individuals in the deliberate mind-set. Thirty-six participants were randomly assigned to the deliberate or implemental mind-set group, and asked to think about writing about one of two conditions (i.e., sexual inexperience and honesty issues in romantic relationships). During the second task, an attitudes measure, participants were either interrupted in the midst of making their decision (deliberative), or were interrupted in the midst of preparing to carry out their decision (implemental). During this interruption, participants were asked to complete an unrelated task (the dependent measure) or to provide their attitudes on whether the U.S. government should be allowed to read foreigner's emails. Results indicated that individuals in the implemental mind-set were almost twice as likely to adopt a one-sided position

towards an issue that was completely unrelated to the goal. Subsequent experiments revealed that individuals in the implemental mind-set expressed the lowest amount of ambivalence towards a variety of objects, evidenced faster evaluative responding than individuals in the deliberative or neutral mind-set, increased their attitudinal strengths while experiencing a decrease of ambivalence, an increase in certainty, an increase of accessibility, and an increase in extremity. These results suggest that individuals who are in the process of acting upon their attitudes are more likely to hold extreme views on the prior attitudes.

Informal Reasoning and Its Relevance to School Psychology

According to Evans and Thompson (2004), one of the most common explanations for why intelligent people fail to reason normatively is that they use informal reasoning processes to solve formal reasoning tasks. For this reason, it can be argued that education in argumentation may help individuals understand the difference between informal reasoning processes and formal reasoning processes.

Van Gelder, Bissett, and Cumming (2004) demonstrated that college students can make substantial gains in their informal reasoning skills in a first year course on critical thinking. Greenhoot and colleagues (2004) discuss the importance of individuals regarding the empirical method as a reliable source of knowledge, irrespective of prior beliefs and individual biases towards phenomena in the world. The critical thinking skills that form the empirical method often involve suspension or rejection of one's prior beliefs in the face of contradictory evidence. Prior beliefs have been shown to be persistent and misconceptions often reappear when questioned weeks or months after a phenomenon has been instructed (Winer, Cottrell, Greeg, Fournier, & Bica, 2002).

With the current push towards evidence-based interventions and instructions, school psychologists need to be up-to-date on both the evidence based intervention and instruction techniques, as well as questionable techniques that may appeal to a wider audience, such as parents. With the increasing availability of the internet as a source for educating parents about educational techniques and interventions, and with some questionable websites publishing unscientific or pseudoscientific techniques for helping their children, school psychologists need to be able to understand the difference between valid formal and informal arguments. School psychologists need to understand that prior beliefs may significantly hinder a parent's ability to recognize why an argument is invalid.

Worrall (1990) argues that individuals who chose treatments of questionable safety or effectiveness for learning disabilities are not fools, unintelligent, or a minority. Instead, Worrall (1990) attributes the reliance on questionable therapies to a flaw in human nature, or more specifically credulity. This means that individuals may not have the time, resources, or expertise to understand treatments and interventions prior to selection, and may be instead relying on the expertise of others when selecting treatments. Thus, school psychologists need to be reliable sources of information to aide in the evaluation of interventions with stakeholders.

Although research has shown that formal instruction in logic is ineffective (Johnson-Laird, 1983), Siegel (1995) argues that educators should be concerned with informal logic for two independent reasons. Firstly, educators should foster the skills and abilities of *reason assessment*, or “evaluate the epistemic force of reasons which can be offered in support of candidate beliefs, claims, and judgments” (pg. 305). Secondly, Siegel (1995) argues for the development of the *critical spirit*, or the complex attitudes, dispositions, habits of mind, and

character traits. Siegel (1995) argues that a person is rational only insofar as that person can systematically and appropriately evaluate such reasons.

This study will specifically evaluate the effect of prior beliefs and attitudes on an individual's ability to recognize and explain an informal reasoning fallacy. Using previous measures of informal reasoning fallacy identification and explanation and previous measures on attitude strength, the researcher will attempt to provide evidence that prior beliefs and attitudes can have a significant effect on the ability to recognize and explain an informal reasoning fallacy.

Research Hypotheses

Primary Hypothesis.

Among university undergraduates, prior beliefs and attitudes towards a topic will have an effect on the acceptance of informal reasoning fallacies based on the same topic. Individuals who have strong positive beliefs and attitudes towards a topic will be more likely to accept informal reasoning fallacies based on that topic. This hypothesis is in agreement with the general research on myside biases, that informal reasoning can be affected by prior belief. Myside biases have not yet shown that the rejection of informal reasoning *fallacies* can be affected by prior beliefs and attitudes.

Secondary Hypotheses.

When viewed through the dual-processing model, ability to reject an informal logical fallacy (based on content) should have no or minimal correlation with one's ability to reject a formal logical fallacy (based on structure). Although this hypothesis runs contrary to some established literature (Ricco, 2007), the dual-processing model predicts that belief bias will have a strong influence on the evaluation of formal logical fallacies, through the automatic

processes of System 1, when the belief and validity of the syllogism are in conflict. In informal logical fallacies, although prior beliefs may have an effect on the evaluation of the fallacy, it is hypothesized that System 2 is activated to account for the informal reasoning (i.e., there is no logical syllogism for System 1 to influence).

Differences in the ability to distinguish informal logical fallacies will be more highly correlated with an individual's attitudes and belief towards the topic than on the form of the informal logical fallacy. If System 2 is activated to evaluate informal reasoning in informal logical fallacies, then the strength of the biases should account more for the acceptance of the informal logical fallacy than the form of the informal logical fallacy. That is, it is hypothesized that the participants will reason (System 2) with the content of the informal logical fallacy to decide whether the argument is valid, instead of assessing the form of the informal logical fallacy (e.g., ad hominem fallacy, ad populum fallacy, etc).

CHAPTER 3

METHODS

Participants

The participants for this study were one hundred sixty-eight (168) university students between the ages of 18 and 55 years ($M = 22.02$; $SD = 4.28$). A power analysis (Cohen, 1992), using 80% power at the alpha level .05, and with a medium effect size suggested 152 participants for this experiment. The participant pool drew from randomly selected university classes held during Summer Session I and Summer Session II classes. The sample consisted of 2 freshmen (1.2%), 16 sophomores (9.5%), 70 juniors (41.4%), 71 seniors (42.0%), and 9 participants stating their academic year as “other” (5.3%) The sample was 14.8% African American / Black, 17.8% Asian / Pacific Islander, 56.8% White, 2.4% Latino(a), and 7.7% describing themselves from another ethnicity. Approximately half of participants had at least one parent who graduated from college.

The sampling strategy consisted of randomly selecting classes from the university course catalog offered during the Summer Session I and Summer Session II classes and recruiting the university professors and graduate student teaching assistants (TAs) teaching these courses. Eighteen (18) university professors and graduate TAs were solicited in Summer Session I and twenty-six (26) university professors and graduate TAs were solicited in Summer Session II. Of the university professors and graduate TAs solicited, eleven (11) agreed to participate in Summer Session I and eight (8) agreed to participate in Summer Session II. Of the total number of students solicited, 49.27% of participants agreed to voluntarily participate in the study. If Temple University professors and TAs chose to allow the graduate student researcher to solicit students in the classes, the graduate student researcher arranged for an appropriate day and time to announce to their classes an

opportunity to be involved in a research study following the class session. The graduate student researcher announced during the last two minutes of class that the students could voluntarily consent to be a participant in the research study, and those who are interested would remain in their seats at the end of class. The prospective participants were informed that participation was completely voluntary, that those who chose to participate might receive additional class credit at the decision of the class professor, and that by participating they were entered into a drawing to win one of three prizes valued at \$100.00. Participants were asked to provide an email address if they wanted to be entered to win the \$100.00, were informed that the email addresses would only be used if the participant had won the prize, and were informed that the email address list would be destroyed following completion of the study. Following the completion of data collection, three participants were selected and contacted by the graduate researcher and reward checks were mailed to each winning participant.

Setting

Participants received an informed consent form and a paper copy booklet of the measures used in this study. Participants were asked to complete the booklet of measures at their class seats using either a pencil or pen following the end of the class session. The time of survey completion varied for each participant, but lasted from approximately 20 minutes to 45 minutes. The *informal fallacy task* and *personal attitudes* questionnaires were counterbalanced and presented as one block. The *formal fallacy task* and *demographics* questionnaires were presented as a second block.

Materials and Variables

Informal fallacy task.

A variation of the informal fallacy identification task developed by Neuman and Weizman (2003), and used successfully in several studies (Neuman, Glasner, & Weinstock, 2004; Neuman et al., 2006; Neuman, 2003; Weinstock, Neuman, & Glasner, 2006; Weinstock, Neuman, & Tabak, 2004; Ricco, 2007), was adapted for this study from the standard version developed by Neuman & Weizman (2003). As with changes made to the measure in Ricco (2007), allowing for partial credit scoring and an increased number of fallacies, these changes were also included in the current version of the task. Additional changes were also made to this task involving the number of fallacies included in each argument. Whereas previous tasks have paired one argument with one fallacy, the current version of this task included each argument presented with a version of all of the fallacies under study. This format followed the general argument structure of the Neuman and Weizman (2003) task, but also included multiple informal fallacy tasks presented at the end of the argument. Each argument began with a main claim in dispute following the form of a question. The participant was introduced to two hypothetical individuals who argue opposing sides of an argument and were described as college students who have a specific reason relevant for their side of the argument. Each hypothetical arguer was assigned a position: pro or con. Finally, several hypothetical reasons were presented from each of the arguers in support of his/her position. This reasoning contains one of six fallacies: *argument ad populum* (appeal to popularity), *argument ad ignorantium* (argument from ignorance), *argument non-cause pro causa* (false cause), *petito principi* (begging the question), *ignoratio elenchi* (irrelevance), *slippery slope*, and one valid argument. An explanation of each fallacy used in this

study can be found in Appendix F. This format is illustrated by the following example, which allows for multiple fallacy tasks stemming from the same argument:

1. Henry and Robert are 19 year-old undergraduate political science majors.
2. During a college seminar they discuss the question: “Should the legal age-limit for drinking alcohol be lowered from 21 to 18 years of age?”
3. Henry argues that the legal limit *should be lowered* to eighteen.
4. Robert argues that the legal limit *should not be lowered* to eighteen.
5. During the discussion Henry argues:
 - a. *“The legal limit should be lowered to eighteen years of age in order to teach young adults to drink safely because a recent Centers for Disease Control (CDC) study indicated that most students who drink safely were exposed to alcohol prior to 21 years old.”* (False Cause)
 - b. *“The legal limit should be lowered to eighteen years of age because young adults deserve it. Society needs to have laws that properly serve the adult population, even if people disagree on lowering the age limit for alcohol use.”* (Begging the Question)
 - c. *“The legal limit should be lowered to eighteen years of age because this is the practice in most other industrialized countries, including most countries in Europe, Latin, and South America.”* (Appeal to Popularity)

During the discussion Robert argues:

- d. *“The legal limit should not be lowered to eighteen years of age because no one has been able to prove that lowering the limit would result in any significant positive effects on our society.”* (Appeal from Ignorance)
- e. *“The legal limit should not be lowered to eighteen years of age, since a recent National Institutes of Health (NIH) study shows that individuals who begin to drink at eighteen instead of twenty-one are more likely to have problems with alcohol abuse later in life.”* (Valid Argument)
- f. *“The legal limit should not be lowered to eighteen years of age because research shows that alcohol is increasingly being sold at public places, such as sporting arenas, concert events, and nightclubs.”* (Irrelevance)
- g. *“The legal limit should not be lowered to eighteen years of age, since lowering the drinking age will necessarily lead to legalization of marijuana and other drugs. Soon there will be no laws to protect our youth.”* (Slippery Slope)

The arguments comprising the informal fallacy task were drawn from two sources:

- (1) a discussion with advanced graduate students and one professor about relevant issues for

undergraduates at the university, and (2) an informal discussion between the researcher and a group of undergraduate colleagues when probing for relevant issues for undergraduate students. The full version of each fallacy measure can be found in Appendix A. Prior to administration, the fallacy arguments were presented independently to three advanced graduate students in order to determine if the statements contained a fallacy and to identify which fallacies were represented. Agreement of 96% was reached by the three independent raters and disagreements were resolved prior to assigning scores on the task.

As with the Ricco (2007) study, each fallacy was followed by two questions. The *fallacy identification* question asked participants whether they believed the reasoning was faulty or problematic in any way. Participants circled either YES, if they believed the reasoning was faulty or problematic, or NO, if they believed the reasoning was valid. The open-response *fallacy explanation* question asked participants to explain what they felt was wrong with the reasoning, if he/she believed the reasoning was faulty. This format allowed for the experimenter to probe both a general understanding of the argument as fallacious as well as an explicit example of the intended fallacy. The informal fallacy topics were counterbalanced within and across participants. Furthermore, the order of the six arguments within each topic was counterbalanced within and across participants.

Following administration of the informal fallacy task, two advanced graduate students rated the justification of the *fallacy explanation*. As in the Ricco (2007) study, participants were given full credit (1.0 points) for a complete statement of the fallacy, partial credit (0.5 points) for an incomplete account of the fallacy, but one that nonetheless captured a key element, and no credit (0.0) for all other justifications. The same scoring criteria used for Ricco (2007) study were used for the present study with permission (Appendix B). Participants received separate scores on their ability to identify an informal

fallacy (*fallacy identification*) and on their ability to explicitly explain the fallacy (*fallacy explanation*). The range of the fallacy identification scores was from 0, signifying that all of the fallacies and the valid argument were incorrectly identified, to 6, at whole number increments, signifying that all of the fallacies were correctly identified. Additionally, participants received one point (1.0) for correctly identifying the valid argument as valid. The ability to identify the valid argument was analyzed separately. The range of the fallacy explanation score was from 0, signifying that all of the fallacies were incorrectly explained by the participant, to 6, at 0.5 number increments, signifying that the participant correctly explained the fallacy. Since no explanation is needed for the valid argument, upon correctly identifying it as valid, no score was provided for the valid argument in the *fallacy explanation* task.

One of the limitations of previous studies addressing attitudes towards arguments is that the researchers have not described how the topics of the arguments were selected, beyond stating that the arguments achieved face validity by two experts in argumentation and by two teachers (Neuman, 2003). Many of the informal arguments utilized by Neuman (2003) have also been used for several other studies of informal reasoning (Neuman & Weizman, 2003; Neuman, Glassner, & Weinstock, 2004; Weinstock, Neuman, & Tabak, 2004; Neuman, Weinstock, & Glasner, 2006; Ricco, 2007). Although Ricco (2007) used several of the arguments from Neuman (2003), he also incorporated several arguments from established critical thinking tasks. Previous research has used a wide variety of topics such as the existence of UFOs, the discipline of criminals, the teaching of young children, the avoidance of tax payment, and the inclusion of exceptional students in the regular education curriculum (Neuman, 2003; Weinstock, Neuman, & Tabak, 2004). In order to determine relevant issues for the projected population of undergraduate students, the investigator used

several methods to determine the topics of the informal arguments. Neuman (2003) used the topic of the existence in God, which produced significant biases based on prior belief.

Furthermore, prior to the construction of the informal fallacy task, the graduate researcher informally asked graduate student colleagues and one professor in an informal round table discussion about issues that would likely affect undergraduate student and also informally asked several undergraduate associates of the graduate researcher what current issues they felt were important and debatable to fellow undergraduates at the university. From these informal discussions with other graduates and undergraduate students at the university, the graduate researcher selected three topics to use for the informal fallacy task (Table 1).

Table 1

Topics Used for Fallacy Identification and Fallacy Explanation Tasks

1. The Alcohol Task: Should the legal limit for drinking alcohol be lowered from 21 years of age to 18 years of age?
 2. The God Task: Does God exist?
 3. The Marriage Task: Should same-sex couples have the same legal rights to marriage as heterosexual couples?
-

Personal attitudes task.

Factors that may effect the production of significant myside reasoning biases and belief bias effects are the participants' prior attitudes, beliefs, and opinions towards each topic, or the importance or "buy-in" of the participants towards the topic in an informal argument. One can reasonably hypothesize that participants in previous studies may not have had a strong opinion on many of these topics, and therefore have little reason to argue strongly for or against the argument. Several studies have compared the effects of confirmation biases, referred to as belief biases or myside biases, on informal reasoning tasks (Neuman, 2003; Neuman, Glasner, & Weinstock, 2004; Neuman & Weizman, 2003;

Stanovich & West, 1997; Toplak & Stanovich, 2003). Previous informal fallacy research, when assessing prior belief about an argument, has asked participants to rate his/her personal agreement with a position on a specific topic on a Likert-type scale. As with previous studies, this study asked participants to rate their agreement on the topic on a seven point Likert-type scale.

In order to assess the attitude strength of the argument, the current study also included a task developed by Krosnick and colleagues (1993), used successfully in Haddock and colleagues (1996) and adapted by Haddock and colleagues (1999). For each informal fallacy task questionnaire, participants were asked to provide on a 7-point Likert-type scale the degree to which they agree with the protagonist in the informal fallacy task, how intense, important, and certain these attitudes are, how often they thought about the issue, and their perceived knowledge about the issue. Additionally, consistent with Henderson and colleagues (2008), an additional question addressed whether the participants would be willing to act upon their attitudes, or how likely the participant was to join a group advocating the position, which provided a different perspective of attitudinal strength (see Appendix D). The order of the attitude strength scale was counterbalanced within and between participants in the experiment.

Using the personal attitudes task, participants received a subjective judgment score, which is the sum of the self-reported subjective attitudes from the Likert-type scale on the attitude importance, attitude intensity, and attitude certainty scores. The scores for subjective judgment ranged from 6 to 42. The participants received a cognitive structure dimension score, which was the sum of the self-reported subjective attitudes from the Likert-type scale on the frequency and knowledge scales. The scores for cognitive structure dimension ranged from 4 to 28. A composite score for personal attitudes combined the subjective judgment

score with the cognitive structure dimension score. The range of the composite score was from 10 to 70. As with previous studies, this study asked participants to rate their agreement on the topic, which ranged in score from 1 to 7. Additionally, participants received an implemental score (Henderson, et al., 2008), signifying how likely the individual was to act on his or her belief, which was assessed by the participants' belief about willingness to join a group advocating the position. The range of the implemental score was from 1 to 7. Since each of the attitude measures developed by Krosnick and colleagues (1993) included two questions addressing each of the attitudinal variables, the additional attitude variables added to this task, the agreement with the topic score and the implemental score, were doubled when calculating a total attitude measure.

Formal logic syllogism task.

Participants completed a formal logic syllogism task to assess their ability to overcome belief bias in formal logic. The research regarding the correlation between individual's ability to identify informal and formal reasoning fallacies is currently mixed. Some research has supported the idea that the performance on informal reasoning fallacies correlates with one's ability to identify formal reasoning fallacies (Ricco, 2007), while other studies have failed to demonstrate this correlation (Neuman, 2004; Ricco, 2003).

In order to compare within subject variables of belief biases on formal and informal logic, two formal logical syllogism tasks derived from Markovits and Nantel (1989) and Morley, Evans, and Handley (2004) were utilized. In the Markovitz and Nantel (1989) and the Morley, Evans, and Handley (2004) studies, eight formal logic syllogisms are consistent, meaning that the syllogisms have a valid form and a believable conclusion or have an invalid form and an unbelievable conclusion and eight formal logic syllogisms that are inconsistent

and beliefs are in conflict, meaning that either the syllogisms have valid form and unbelievable conclusions or have invalid forms and believable conclusions.

The consistency between logic and belief is illustrated in the following examples:

Premises: No deep sea divers are smokers.
Some smokers are good swimmers.
Conclusion: Some good swimmers are not deep sea divers. (*valid-believable*)

Premises: No highly trained dogs are vicious.
Some vicious dogs are police dogs.
Conclusion: Some highly trained dogs are not police dogs (*invalid-believable*)

The inconsistency between logic and belief is illustrated in the following examples:

Premises: All things that are smoked are good for the health.
Cigarettes are smoked.
Conclusion: Cigarettes are good for the health. (*valid-unbelievable*)

Premises: All flowers have petals.
Roses have petals.
Conclusion: Roses are flowers. (*invalid-believable*)

Participants were asked to decide whether the stated conclusion follows logically from the premises. The participants were told to suppose that all of the premises were true and that the participants were to limit themselves only to the information provided in the premises. For each problem, the participants were asked to circle a YES or a NO directly under each syllogism. The participants were told to circle YES if the conclusion follows *unequivocally* from the premises, otherwise the participants were instructed to circle NO. Scores ranged from 0, signifying each formal logical syllogism was incorrectly identified as valid or invalid, to 16, signifying each formal logical syllogism was correctly identified as valid or invalid. All measures were used with permission from the original researchers.

Demographics Questionnaire.

The participants were asked to provide demographic characteristics, including their age, gender, ethnicity, academic major, current academic year, highest parental level of

education, family income level, and current estimated grade point average. Demographic characteristics of the sample can be found in Table 2.

Table 2
Demographic Characteristics of the Sample

Variable	N	%
<u>Gender</u>		
Female	92	54.4
Male	76	45.0
(Missing Data)	1	.6
<u>Age</u>		
18 - 19	18	10.7
20 - 21	78	46.2
22 - 23	47	27.8
24 - 55	25	14.8
(Missing Data)	1	.6
<u>Academic Year</u>		
Freshmen	2	1.2
Sophomore	16	9.5
Junior	70	41.4
Senior	72	42.0
Other	9	5.3
(Missing Data)	1	.6
<u>Academic College</u>		
Boyer College of Music and Dance	1	.6
College of Communication and Theatre	9	5.3
College of Education	10	5.9
College of Health Professions	10	5.9
College of Liberal Arts	38	22.5
College of Science and Technology	24	14.2
Fox School of Business	60	35.5
Tourism and Hospitality Management	5	3.0
Tyler School of Art	5	3.0
Undeclared	6	3.5
(Missing Data)	1	.6
<u>Race/Ethnicity</u>		
African American / Black	25	14.8
Asian/Pacific Islander	30	17.8
White	96	56.8
Latino(a)	4	2.4
Other	13	7.7
(Missing Data)	1	.6

<u>Highest Level of Parental Education</u>		
Some high school education	2	1.2
High school diploma	28	16.6
Some college	40	23.7
Associate degree	15	8.9
Bachelor degree	44	26.0
Post-graduate degree	39	23.1
(Missing Data)	1	.6
<u>Estimated Family Income</u>		
Less than \$30,000	27	16.0
\$30K – 49,999	22	13.0
\$50K – 74,999	40	23.7
\$75K – 99,999	23	13.6
\$100K or More	53	31.4
(Missing Data)	4	2.4

Data Analysis

All questionnaires in this study remained anonymous. All questionnaires and test materials were collected from participant upon completion of the study. Two scores were used from the informal fallacy task: the *fallacy identification* question and the *fallacy explanation* question. For the *fallacy identification* question, participants received a score of one if they correctly identify each argument as fallacious (circle YES). Participants received a score of zero if they incorrectly identified the fallacy as valid (circle NO). For the *fallacy explanation* task, two advanced graduate students independently scored the open responses on the informal fallacy task using the scoring criteria in Ricco (2007). The advanced graduate students obtained inter-rater agreement of .943 with disagreement between the graduate students resolved through discussion. Table 3 displays the inter-rater agreement for each of the fallacy explanation tasks. Participant data were then entered into a SPSS database by the graduate researcher.

Table 3
Inter-rater Agreement for Fallacy Explanation Task

Alcohol Task	.937
God Task	.938
Marriage Task	.952
Total	.943

For the *formal logic syllogism task*, the participants received a score of one on each item when they properly circle YES if the conclusion follows *unequivocally* from the premises, or circle NO when the conclusion does not follow logically from the premises. All incorrect responses received a score of zero. Using a master-coding sheet with correct answers identified, the participants received scores for the *formal logic syllogism task*.

Demographic data were evaluated using descriptive statistics and frequencies. A composite score of total attitude strength was created that combined the self-reported attitude measures on the *attitude strength task* (10 items). The agreement item (item 1 on the *attitude strength task*) and the implemental item (item 12 on the *attitude strength task*) will be kept out of the total attitude strength composite score. Table 4 displays the scoring criteria and scoring range for each of the research measures.

Table 4
Scoring Criteria and Range for Each Research Measure

<i>Measure</i>	<i>Scores Ranges</i>
Informal Fallacy Task – Identification	0 – 6 points, with 1 point increments For each fallacy task
Informal Fallacy Task – Valid Argument	1 point for correctly identifying the valid argument For each fallacy task
Informal Fallacy Task – Explanation	0 – 6 points with 0.5 point increments For each fallacy task
Personal Attitudes Task – Subjective Dimension	6 – 42 points
Personal Attitudes Task – Cognitive Dimension	4 – 28 points
Personal Attitudes Task – Composite (Subjective and Cognitive Dimension)	10 – 70 points
Personal Attitudes Task – Agreement	1 – 7 points
Personal Attitudes Task – Implement	1 – 7 points
Attitudinal Composite	14 – 98 points
Formal Logic Syllogism Task	0 – 16 points
Demographics Questionnaire	Age Gender Ethnicity Academic major Current academic year Highest parental level of education Family income level Current estimated grade point average

CHAPTER 4

RESULTS

Attitudes Toward the Tasks

In order to assess participants' attitudes towards the tasks (i.e., the alcohol task, the God task, and the marriage task), participants rated their agreement with the topic statement, their willingness to implement their attitude towards a position by joining a group advocating the position, the importance of their attitudes towards the position, the intensity of their attitudes towards the position, the certainty of their attitudes towards the position, the frequency they thought and talked about their attitudes towards the position, and their perceived knowledge regarding the position, on seven-point Likert-type scales. The task had two questions assessing each of the domains in the attitude measure (i.e., importance, intensity, certainty, frequency, and knowledge) making the range of attitude scores from 2 – 14. The scores for the agreement variable and the implement variable were doubled to allow consistent scores across the attitude variables. The means and standard deviations for the attitude measure are presented in Table 5.

Table 5
Means and Standard Deviations for the Attitude Measure

	<i>Alcohol Task</i>		<i>God Task</i>		<i>Marriage Task</i>	
	Mean	SD	Mean	SD	Mean	SD
Agreement	7.54	3.97	9.64	4.20	9.86	4.24
Implement	5.55	3.87	6.69	4.30	6.24	4.16
Importance	7.26	3.42	10.10	3.76	8.05	3.71
Intensity	7.74	3.39	9.66	3.76	8.79	3.51
Certainty	9.44	3.43	10.27	3.52	10.38	3.64
Frequency	6.08	3.38	9.12	3.35	6.29	2.79
Knowledge	7.87	2.98	10.11	3.52	8.68	3.04

In order to assess if participants' attitude scores were significantly different across attitude measures, study tasks, and whether there was an interaction between the two, a doubly multivariate repeated analysis of variance (ANOVA) was used. Where circularity assumptions are met, scores are reported with be Sphericity Assumed. When circularity assumptions are not met, the Greenhouse-Geisser corrections were used. Table 6 presents the doubly multivariate repeated analysis of variance (ANOVA) results for scores for attitudes across tasks.

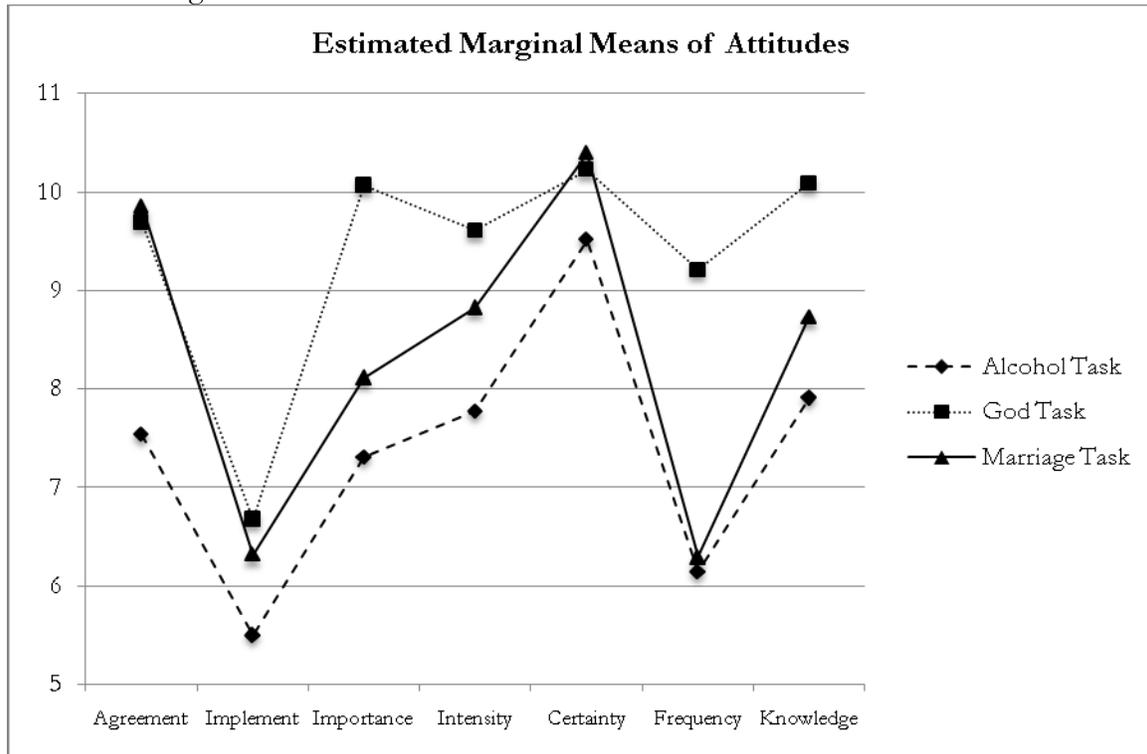
Table 6

Doubly Multivariate Repeated Analysis of Variance (ANOVA) for Attitude Measure

Source		df	Mean Square	F	Significance	Partial Eta Squared
Attitudes	Greenhouse-Geisser	6	804.990	111.928	.000	.409
Error (Attitudes)	Greenhouse-Geisser	972	7.192			
Task	Greenhouse-Geisser	2	1123.146	20.705	.000	.113
Error (Task)	Greenhouse-Geisser	324	54.245			
Attitudes*Task	Greenhouse-Geisser	12	66.013	11.779	.000	.068
Error (Attitudes*Task)	Greenhouse-Geisser	1944	5.604			

Participants significantly differed in their attitudes on the measures within each topic ($F(6,972) = 111.928, p < .000, \text{partial } \eta^2 = .409$), and based on topic (i.e., the alcohol task, the God task, and the marriage task) ($F(2,324) = 20.705, p < .000, \text{partial } \eta^2 = .113$), and there was a significant interaction between these two variables ($F(12,1944) = 11.779, p < .000, \text{partial } \eta^2 = .068$).

Figure 1
Estimated Marginal Means of Attitudes



As a follow-up to the doubly multivariate repeated analysis of variance, paired-sample t-tests were completed in order to determine differences between variables. For the Agreement variable, participants rated significantly higher on the God task than the alcohol task ($t(165) = 4.619, p = .000$), and the marriage task than the alcohol task ($t(166) = 5.496, p = .000$). There was no significant difference between the marriage task and the God task. For the Implement variable, participants rated significantly higher on the God task than the alcohol task ($t(166) = 2.714, p = .007$). There was no significant difference between the alcohol task and the marriage task, and the God task and the marriage task. For the Importance variable, participants rated significantly higher on the God task than the alcohol task ($t(166) = 7.873, p = .000$), significantly higher on the marriage task than the alcohol task ($t(167) = 2.168, p = .032$), and significantly higher on the God task than marriage task

($t(166) = 5.030, p = .000$). For the intensity variable, participants rated significantly higher on the God task than the alcohol task ($t(166) = 5.399, p = .000$), rated significantly higher on the marriage task than the alcohol task ($t(167) = 3.011, p = .003$), and significantly higher on the God task than the marriage task ($t(166) = 2.246, p = .026$). For the Certainty variable, participants rated significantly higher on the God task than the alcohol task ($t(165) = 2.094, p = .038$), and significantly higher on the marriage task than the alcohol task ($t(167) = 2.596, p = .010$). There was no significant difference between the God task and the marriage task. For the Frequency variable, participants rated significantly higher on the God task than the alcohol task ($t(165) = 8.519, p = .000$), and significantly higher on the God task than the marriage task ($t(166) = 10.008, p = .000$). There was no significant difference between the alcohol task and the marriage task. For the Knowledge variable, participants rated significantly higher on the God task than the alcohol task ($t(165) = 6.732, p = .000$), significantly higher on the marriage task than the alcohol task ($t(166) = 2.713, p = .007$), and significantly higher on the God task than the marriage task ($t(166) = 4.656, p = .000$).

Informal Fallacy Identification

In order to examine participant ability to assess whether the reasoning in arguments was faulty or problematic, the informal fallacy identification task presented participants with six different informal fallacies (Appeal to Popularity, Argument from Ignorance, Begging the Question, False Cause, Irrelevance, and Slippery Slope) across three scenarios: the alcohol task, the God task, and the marriage task. Participants received a score of one for correctly identifying that the reasoning in the argument was faulty or problematic, and a zero for incorrectly identifying the each fallacy task. The means and standard deviations of the informal fallacy identification by task scenarios are presented in Table 7. In the fallacy

identification task, participants needed to determine whether they believed the reasoning was faulty or problematic in any way. Therefore, participants, by chance had a 50% chance of determining the fallacy by chance alone. A one-sample t-test was used with a test value = .5 in order to determine whether participants identified the fallacies at a rate better than chance.

Table 7
One-Sample T-Test of Informal Fallacy Identification by Task

	<i>Alcohol Task</i>		<i>God Task</i>		<i>Marriage Task</i>	
	Mean	SD	Mean	SD	Mean	SD
Appeal to Popularity	.5595	.49793	.4337	.49709	.6946***	.46196
Argument from Ignorance	.5060	.50146	.6867***	.46522	.6467***	.47943
Begging the Question	.5417	.49975	.6218**	.48650	.4061*	.49259
False Cause	.2857***	.45310	.7410***	.43943	.7545***	.43168
Irrelevance	.6250**	.48557	.6250***	.45188	.4072*	.49279
Slippery Slope	.7143***	.45310	.5677	.49700	.8084**	.39476

* $p < .05$

** $p < .01$

*** $p < .001$

For the alcohol task, participants scored significantly better than chance for the “irrelevance” fallacy ($t(167) = 3.337, p = .001$), and the “slippery slope” fallacy ($t(167) = 6.130, p = .000$), and significantly worse than chance for the “false cause” fallacy ($t(167) = -6.130, p = .000$). For the God task, participants scored significantly better than chance for the “argument from ignorance” fallacy ($t(165) = 5.172, p = .000$), the “begging the question” fallacy ($t(155) = 3.127, p = .002$), the “false cause” fallacy ($t(165) = 7.065, p = .000$), and the “irrelevance” fallacy ($t(165) = 6.183, p = .000$). For the marriage task, participants scored significantly better than chance for the “appeal to popularity” fallacy ($t(166) = 5.444, p =$

.000), the “argument from ignorance” fallacy ($t(166) = 3.954, p = .000$), the “false cause” fallacy ($t(166) = 7.618, p = .000$), and the “slippery slope” fallacy ($t(166) = 10.095, p = .000$), and significantly worse than chance for the “begging the question” fallacy ($t(166) = -2.450, p = .015$) and the “irrelevance” fallacy ($t(166) = -2.434, p = .016$).

Research Question 1: Are prior beliefs and attitude strength related to participant performance on the informal logical fallacies task?

The hypothesis that prior beliefs and attitude strength are related to the ability to identify and reject informal logical fallacies was tested using this data. A linear regression was used to determine if the components of attitude strength singly and in combination predict the ability to identify and reject informal logical fallacies using the informal fallacy identification task. The single attitude strength variables are attitude importance, intensity, certainty, frequency, and knowledge. The importance, intensity, and certainty variables also combine to form the subjective judgment score, and the frequency and knowledge variables combine to form the cognitive judgment score. Table 8 presents the full-scale linear regression for the measures of attitude strength and fallacy identification.

The linear regression on the marriage task scores was significant, $R^2 = .179, F(7, 159) = 7.059, p < .001$, and produced a model that included the participants’ perceived certainty regarding that position that same-sex couples should have equal rights to marriage and perceived frequency in which the participants’ thought and talked about the position. The regressions on the alcohol task and God task were found to be non-significant.

Table 8

Full-Scale Linear Regression for the Single and Combined Measures of Attitude Strength and Fallacy Identification

<i>Attitude</i>	<i>Alcohol Task</i>		<i>God Task</i>		<i>Marriage Task</i>	
	Beta	t	Beta	t	Beta	t
Subjective Judgment Score	.151	1.494	-.176	-1.598	.260	2.457*
Importance	-.269	-1.787	.055	.386	-.147	-1.141
Intensity	.464	2.722**	-.361	-2.309*	-.087	-.546
Certainty	-.043	-.394	.142	1.066	.458	3.884**
Cognitive Judgment Score	-.092	-.908	.123	1.119	.050	.475
Frequency	-.047	-.475	.234	2.239*	.231	2.151*
Knowledge	-.072	-.713	-.093	-.819	-.109	-1.224

* $p < .05$

** $p < .01$

It was hypothesized that the attitude strength variables, in combination would predict the ability to reject informal logical fallacies in the fallacy identification task. The linear regression in the marriage task scores was significant with respect to the combined judgment scores, $R^2 = .088$, $F(2, 167) = 8.001$, $p < .001$, and produced a model that included the participants' subjective judgment score on the rights of same-sex couples to have equal rights to marriage. The linear regressions on the alcohol task and God task were found to be non-significant.

Research Question 2: Do individuals vary in their performance on informal logical fallacies task across fallacy topics?

The hypothesis that participants will differ on their ability to identify informal logical fallacies based on the informal fallacy topic (i.e., the alcohol task, the God task, and the

marriage task) was tested by the information collected from these participants. Participants' scores were analyzed using a doubly multivariate repeated analysis of variance (ANOVA) in order to determine if individuals differed on the ability to identify informal logical fallacies based on the fallacy topic. Table 9 presents the doubly multivariate repeated analysis of variance (ANOVA) results for scores for indentifying fallacies based on fallacy topic.

Table 9
Doubly Multivariate Repeated Analysis of Variance (ANOVA) for Fallacy Identification

Source		df	Mean Square	F	Significance	Partial Eta Squared
Fallacy	Greenhouse-Geisser	4.764	1.707	9.184	.000	.057
Error (Fallacy)	Greenhouse-Geisser	725.062	.186			
Topic	Greenhouse-Geisser	1.973	2.193	9.216	.000	.057
Error (Topic)	Greenhouse-Geisser	299.843	.238			
Fallacy*Topic	Greenhouse-Geisser	7.765	5.382	22.536	.000	.129
Error (Fallacy*Topic)	Greenhouse-Geiseer	1180.315	.239			

Participants were significantly more likely to identify the fallacy in the God task than the alcohol task ($t(167) = 2.901, p = .004$), and were significantly more likely to identify the fallacy in the marriage task than the alcohol task ($t(167) = 3.257, p = .001$). There was no significant difference between performance on the God task and the marriage task.

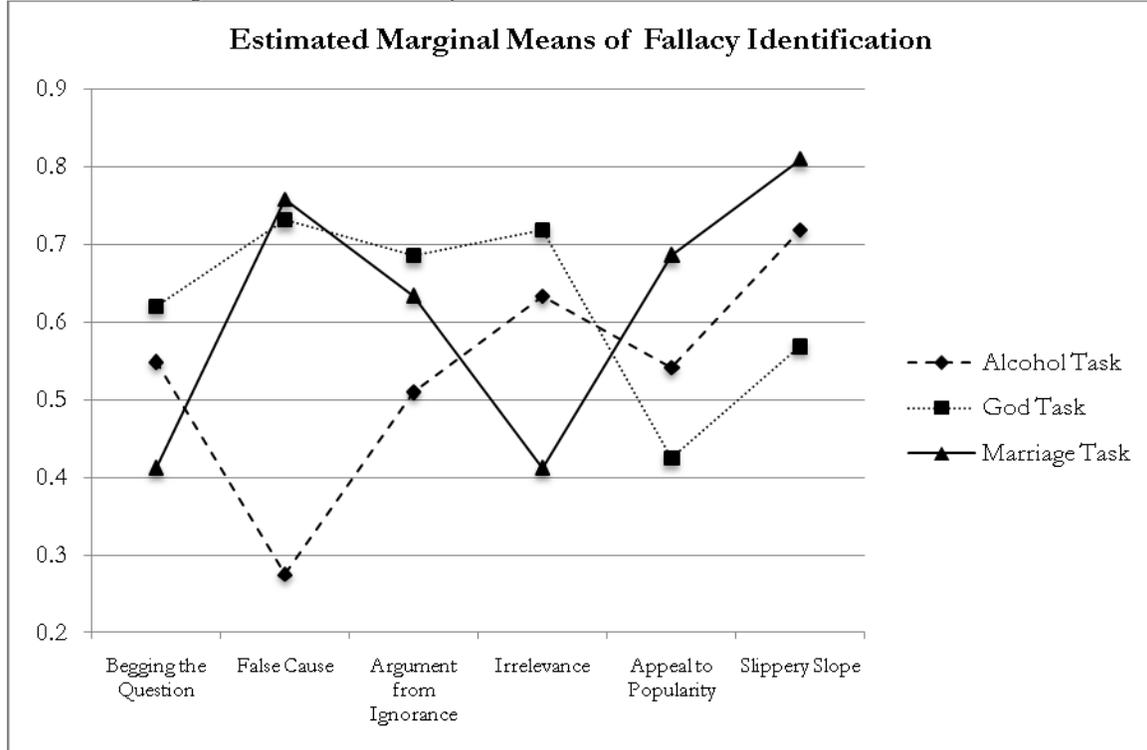
Research Question 3: Do individuals vary in their performance on informal logical fallacies across fallacies?

The hypothesis that participants will differ on their ability to identify informal logical fallacies based on the informal fallacy type (i.e., Appeal to Popularity, Argument from

Ignorance, Begging the Question, False Cause, Irrelevance, and Slippery Slope) was tested by information collected from these participants. First, the participants' scores for each fallacy was summed within each topic, in order to determine a total score for each fallacy for each participant. Secondly, participants' scores were analyzed using a doubly multivariate repeated analysis of variance (ANOVA) in order to determine if individuals differed on the ability to identify informal logical fallacies based on fallacy type. Table 9 presents the doubly multivariate repeated analysis of variance (ANOVA) results for scores for indentifying fallacies based on fallacy type. Thirdly, the doubly multivariate repeated analysis of variance (ANOVA) was used to determine if there was an interaction between the fallacy type variable and fallacy topic variable.

Participants significantly differed on their ability to identify informal logical fallacies based on the informal fallacy type (i.e., Appeal to Popularity, Argument from Ignorance, Begging the Question, False Cause, Irrelevance, and Slippery Slope) ($F(5,760) = 9.184, p < .001, \text{partial } \eta^2 = .057$), and based on topic (i.e., the alcohol task, the God task, and the marriage task) ($F(2,304) = 9.216, p < .001, \text{partial } \eta^2 = .057$), and there was a significant interaction between these two variables ($F(10,1520) = 4.179, p < .001, \text{partial } \eta^2 = .129$). These tests were followed up with paired-sample t-tests in order to determine the differences between variables.

Figure 2
Estimated Marginal Means of Fallacy Identification



For the “begging the question” fallacy, participants were significantly more likely to identify the fallacy in the alcohol task than the marriage task ($t(164) = 2.669, p = .008$), and identify the fallacy in the God task than the marriage task ($t(153) = 3.933, p = .000$). There was no significant difference between the alcohol task and God task groups. For the “false cause” fallacy, participants were significantly more likely to identify the fallacy in the God task than the alcohol task ($t(165) = 10.325, p = .000$), and in the marriage task than the alcohol task ($t(166) = 9.439, p = .000$). There was no significant difference between the God task and marriage task. For the “argument from ignorance” fallacy, participants were significantly more likely to identify the fallacy in the God task than the alcohol task ($t(165) = 3.887, p = .000$), and in the marriage task than the alcohol task ($t(166) = 2.849, p = .005$). There was no significant difference between the God task and marriage task. For the “irrelevance” task, participants were significantly more likely to identify the fallacy in the

God task than the alcohol task ($t(165) = 2.052, p = .042$), identify the fallacy in the alcohol task than the marriage task ($t(166) = 4.283, p = .000$), and identify the fallacy in the God task than the marriage task ($t(165) = 6.601, p = .000$). For the “appeal to popularity” task, participants were significantly more likely to identify the fallacy in the alcohol task than the God task ($t(165) = 2.293, p = .023$), were significantly more likely to identify the fallacy in the marriage task than the alcohol task ($t(166) = 2.599, p = .010$), and were significantly more likely to identify the marriage task than the God task ($t(165) = 6.197, p = .000$). For the “slippery slope” fallacy, participants were significantly more likely to identify the fallacy in the alcohol task than the God task ($t(154) = 3.247, p = .001$), were significantly more likely to identify the fallacy in the marriage task than the alcohol task ($t(166) = 2.213, p = .028$), and were significantly more likely to identify the marriage task than the God task ($t(154) = 5.218, p = .000$).

Since the fallacy identification variables are discrete, a more conservative analysis of Chi-Square tests were also run with the percentages of correct fallacy identifications. In the “appeal to popularity” fallacy, participants were significantly more likely to identify the marriage (69.5%) task than the alcohol (56.0%) task and significantly more likely to identify the alcohol (56.0%) task than the God task (43.4%; $\chi^2(2) = 23.038, p < 0.01$). Participants were significantly more like to identify the “argument from ignorance” fallacy on the God (68.7%) and Marriage (64.7%) tasks than on the alcohol task (50.6%, $\chi^2(2) = 12.718, p < 0.01$). Participants were significantly more likely to identify the “begging the question” fallacy on the alcohol (54.2%) and God (62.2%) tasks than on the marriage task (40.6%; $\chi^2(2) = 15.534, p < 0.01$). For the “false cause” fallacy, participants were significantly more likely to identify the fallacy on the God (74.1%) and marriage (75.4%) tasks than on the alcohol task (59.3%; $\chi^2(2) = 98.816, p < 0.01$). Participants were significantly more like to identify the

“irrelevance” fallacy on alcohol (62.5%) and God (71.7%) tasks than on the marriage task (40.7%; $\chi^2(2) = 34.685, p < 0.01$). In the “slippery slope” fallacy, participants were significantly more likely to identify the marriage (80.8%) and alcohol (71.4%) tasks than the God task (56.8%; $\chi^2(2) = 22.416, p < 0.01$). The chi-square analysis produced the same results as the doubly multivariate repeated analysis of variance (ANOVA). The “valid” question was not shown to be a significant predictor of the ability to reject informal logical fallacies.

Research Question 4: Does individual performance on the informal logical fallacies task predict performance on the formal logical fallacies task?

Participants completed a formal fallacy measure, which assessed their ability to overcome belief bias in sixteen logical syllogisms. It was hypothesized that participant score on the logical syllogism task will be a predictor of the ability to identify informal logical fallacies. Table 10 presents the Pearson correlations for scores on formal fallacy measures and scores for informal fallacy identification.

Table 10
 Pearson Correlations for Scores
 on Formal Fallacy Measure and
 Informal Fallacy Identification

	r
Alcohol Task	.218*
God Task	.274**
Marriage Task	.340*

* $p < .01$

** $p < .001$

The Pearson correlations for scores on formal fallacy measure and informal fallacy identification task were found to be significant in the alcohol task, $r(165) = .218, p < .01$, in the God task, $r(165) = .274, p < .001$, and in the marriage task, $r(165) = .340, p < .001$.

Research Question 5: Is agreement with the protagonist's position related to performance on the informal logical fallacies task?

Participants were asked to rate, on a seven-point Likert-type scale, their agreement with each of the fallacy tasks: agreement with lowering the legal drinking age to 18 (alcohol task), the existence of God (God task), and same-sex couples having equal rights to marriage (marriage task). It was hypothesized that agreement with the task position would predict the ability of participants to reject informal logical fallacies. Table 11 presents the Pearson correlations for agreement with task position and scores for informal fallacy identification.

Table 11
Pearson Correlations for Agreement with Task Position and Informal Fallacy Identification

	r
Alcohol Task	-.044
God Task	-.171*
Marriage Task	.375**

* $p < .05$

** $p < .001$

The Pearson correlations for agreement with task position was found to be significant in the God task, $r(164) = -.171, p < .05$, and in the marriage task, $r(165) = .375, p < .001$. The Pearson correlation on the alcohol task was found to be non-significant.

Participants were asked to rate, on a seven-point Likert-type scale, their perceived intention to implement their attitudes, which in this case was to join a group that advocated the participants' position, with each of the fallacy tasks: agreement with lowering the legal drinking age to 18 (alcohol task), the existence of God (God task), and same-sex couples having equal rights to marriage (marriage task). It was hypothesized that willingness to join a group that advocated their position would predict the ability of participants to reject

informal logical fallacies. Table 12 presents the Pearson correlation for implementation of attitudes with task position and scores for informal fallacy identification

Table 12
 Pearson Correlations for Implementation
 of Attitudes with Task Position and
 Informal Fallacy Identification

	r
Alcohol Task	-.117
God Task	-.222*
Marriage Task	.259*

* $p < .01$

The Pearson correlation for implementation of attitudes with task position was found to be significant in the God task, $r(165) = -.222, p < .01$, and the marriage task, $r(167) = .259, p < .01$. The Pearson correlation on the alcohol task was found to be non-significant.

Research Question 6: Do any of the demographic variables predict performance on the informal logical fallacies task?

Participants were asked to provide demographics information following the completion of the study measures. Participants were asked to provide their gender, age, race, academic major, academic year, grade point average, highest parent level of education, and estimated family income. Results indicate that the demographic variables were only a significant predictor for the sum of the informal fallacy identification in the marriage task ($F(6,154) = 3.382, p = .004, \text{adjusted } R^2 = .081$), and produced a model with grade point average and family income were significantly positively correlated with ability to identify fallacies. The demographic variables were not significant predictors for the sum scores for the alcohol task and the God task. When the demographic variables were entered individually as between-subject factors in the doubly multivariate repeated analysis of

variance, several demographic variables were significant. Participants significantly differed on the topic (i.e., the alcohol task, the God task, and the marriage task) by gender ($F(2,302) = 3.434, p < .05, \text{partial } \eta^2 = .022$), where males ($M = .676, SD = .033$) scored significantly higher on the God task than females ($M = .581, SD = .031$). For participant ethnicity, the participants were grouped into the categories of Caucasian, African American, Asian/Pacific Islander, and Other. Participants significantly differed on the topic (i.e., the alcohol task, the God task, and the marriage task) by ethnicity ($F(6,298) = 3.574, p < .01, \text{partial } \eta^2 = .067$), and in the interaction between the fallacy task by topic by ethnicity ($F(30,1490) = 1.970, p < .01, \text{partial } \eta^2 = .038$). Participants significantly differed on the topic (i.e., the alcohol task, the God task, and the marriage task) by grade point average ($F(14,284) = 2.120, p < .05, \text{partial } \eta^2 = .095$), where participants tended to answer consistently across topics as grade point average improved.

Research Question 7: Do prior attitudes and beliefs, demographic information, or formal logical fallacy identification best predict performance on the informal logical fallacy task?

In order to assess the model of the best predictors for one's ability to identify informal logical fallacies, the variables agreement with the position, willingness to implement beliefs, the combined attitude measures, and the scores on the formal logical syllogisms were placed into a linear regression. Table 13 presents a model for the best predictors for informal fallacy identification. The combined attitude strength variables (i.e., Subjective Judgments Combined and Cognitive Judgments Combined) within this analysis are in agreement with previous literature on the relative loading of each of the attitude strength variables.

Table 13
 Predictor Variables for Identifying Informal Logical Fallacies

	<i>Alcohol Task</i>		<i>God Task</i>		<i>Marriage Task</i>	
	Beta	t	Beta	t	Beta	t
Agreement	.021	.200	-.113	-1.054	.265	2.714**
Implement	-.197	-1.973	-.204	-2.118*	-.044	-.436
Subjective Judgments Combined	.242	2.330*	.038	.297	.133	1.201
Cognitive Judgments Combined	-.058	-.535	.131	1.197	-.009	-.087
Formal Logic Syllogism Score	.242	3.140**	.257	3.359**	.252	3.426**

*p < .05

**p < .01

The linear regression for predictor variables for identifying informal logical fallacies was significant for the alcohol task ($F(5,158) = 3.378$, $p = .006$, adjusted $R^2 = .068$), the God task ($F(5,158) = 5.263$, $p = .000$, adjusted $R^2 = .116$), and the marriage task ($F(5,160) = 8.491$, $p = .000$, adjusted $R^2 = .185$). Within the full-scale linear regression for the single and combined measures of attitude strength and fallacy identification (Table 8), attitude Importance, Intensity, and Certainty loaded differently across tasks (i.e., either positively correlated or negatively correlated with performance) for Subjective Judgments Combined, and attitude Frequency and Knowledge loaded differently across tasks (i.e., either positive correlated or negatively correlated with performance). Since the individual attitude strength variables loaded differently within this research than previous research, this difference in loading may be masking significant variables in the regression when combined in the

Subjective Judgments Combined and the Cognitive Judgments Combined. For this reason, this analysis was also run with the individual attitude strength variables for Subjective Judgments Combined (i.e., Importance, Intensity, and Certainty) and Cognitive Judgments Combined (i.e., Frequency and Knowledge). Table 14 presents a model for the best predictors for informal fallacy identification with the single attitude strength variables.

Table 14
 Predictor Variables With Single Attitude Strength Variables for Identifying Informal Logical Fallacies

	<i>Alcohol Task</i>		<i>God Task</i>		<i>Marriage Task</i>	
	Beta	t	Beta	t	Beta	t
Agreement	-.011	-.096	-.115	-1.065	.175	1.733
Implement	-.187	-1.770	-.238	-2.464*	-.032	-.317
Importance	-.201	-1.307	.143	.991	-.084	-.664
Intensity	.483	2.905**	-.240	-1.563	-.110	-.705
Certainty	-.040	-.374	.175	1.348	.338	2.751**
Frequency	-.021	-.182	.242	2.352*	.161	1.489
Knowledge	-.040	-.400	-.083	-.758	-.109	-1.254
Formal Logic Syllogism Score	.238	3.085**	.222	2.832**	.231	3.175**

*p < .05

**p < .01

The linear regression for predictor variables with single attitude strength variables for identifying informal logical fallacies was significant for the alcohol task ($F(8,155) = 2.909$, $p = .005$, adjusted $R^2 = .086$), the God task ($F(8,155) = 4.075$, $p = .000$, adjusted $R^2 = .131$), and the marriage task ($F(8,157) = 6.646$, $p = .000$, adjusted $R^2 = .215$).

Informal Fallacy Explanation

In order to examine participant ability to explain why the reasoning in arguments was faulty or problematic, the informal fallacy explanation task presented participants with six different informal fallacies (Appeal to Popularity, Argument from Ignorance, Begging the Question, False Cause, Irrelevance, and Slippery Slope) across three scenarios: the alcohol task, the God task, and the marriage task. Participants were asked to provide an explanation of why they believed the reasoning was faulty or problematic for each of the fallacy identification items labeled as such. Participants received one point (1) for correctly explaining why the reasoning in the argument was faulty or problematic, a score of half a point (0.5) for an incomplete account of the fallacy, but one that nonetheless captured a key element, and zero points (0) for all other responses. The means and standard deviations of the informal fallacy explanation by task scenarios are presented in Table 15. The range of scores on the informal fallacy explanation task is from zero (0), indicating that no correct explanations were provided, to seven (7) indicating that all correct explanations were provided, at half-point (0.5) intervals. Therefore, a mean of approximately one would indicate that a participant received full credit (1 point) on one informal fallacy explanation or partial credit (0.5) on two informal fallacy explanations.

Table 15
Descriptive Statistics for Sum of Informal Fallacy Explanation

	<i>N</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Mean</i>	<i>Std. Deviation</i>
Alcohol Task	169	.00	3.50	.7544	.85760
God Task	169	.00	6.00	1.0799	1.15385
Marriage Task	169	.00	5.00	.8964	1.03348

Research Question 1: Are prior beliefs and attitude strength related to participant performance on the informal logical fallacies task?

The hypothesis that prior beliefs and attitude strength are related to the ability to explain informal logical fallacies was tested using these data. A linear regression was used to determine if the components of attitude strength singly and in combination predict the ability to identify and reject informal logical fallacies using the informal fallacy identification task. Table 16 presents the full-scale linear regression for the measures of attitude strength and fallacy explanation. None of the regressions were found to be significant.

Table 16
Full-Scale Linear Regression for the Single Measures of Attitude Strength and Fallacy Explanation

<i>Attitude</i>	<i>Alcohol Task</i>		<i>God Task</i>		<i>Marriage Task</i>	
	Beta	t	Beta	t	Beta	t
Subjective Judgment Score	-.038	-.375	-.053	-.480	.228	2.118*
Importance	-.214	-1.405	.080	.557	.143	1.035
Intensity	.168	.977	-.353	-2.237*	-.009	-.050
Certainty	.012	.111	.206	1.537	.137	1.086
Cognitive Judgment Score	.028	.273	.071	.644	.008	.071
Frequency	.138	1.385	.070	.663	-.027	-.235
Knowledge	-.131	-1.286	.043	.376	.024	.249

* $p < .05$

None of the regressions for the single measures of attitude strength and fallacy explanation were found to be significant. The regression on the marriage task scores was significant with respect to the combined subjective judgment scores, $R^2 = .054$, $F(2, 167) = 4.753$, $p < .05$, and produced a model that included the participants' subjective judgment score on the rights of same-sex couples to have equal rights to marriage. The regressions on

the alcohol task and God task were found to be non-significant for the combined measures of attitude strength.

Research Question 2: Do individuals vary in their performance on informal logical fallacies task across fallacy topics?

The hypothesis that participants will differ on their ability to explain informal logical fallacies based on the informal fallacy topic (i.e., the alcohol task, the God task, and the marriage task) was tested by the information collected from these participants. Participants' scores were analyzed using a doubly multivariate repeated analysis of variance (ANOVA) in order to determine if individuals differed on the ability to explain informal logical fallacies based on the fallacy topic. Table 17 presents the doubly multivariate repeated analysis of variance (ANOVA) results for scores for indentifying fallacies based on fallacy topic.

Table 17
Doubly Multivariate Repeated Analysis of Variance (ANOVA) for Fallacy Explanation

Source		df	Mean Square	F	Significance	Partial Eta Squared
Fallacy	Greenhouse-Geisser	4.712	1.570	18.927	.000	.108
Error (Fallacy)	Greenhouse-Geisser	739.767	.083			
Topic	Greenhouse-Geisser	1.850	.751	8.172	.000	.049
Error (Topic)	Greenhouse-Geisser	290.484	.092			
Fallacy*Topic	Greenhouse-Geisser	8.127	2.046	22.067	.000	.123
Error (Fallacy*Topic)	Greenhouse-Geisser	1275.988	.093			

Participants were significantly more likely to explain the fallacy in the God task than the alcohol task ($t(167) = 4.817, p = .000$), were significantly more likely to explain the fallacy in the marriage task than the alcohol task ($t(167) = 2.188, p = .030$), and were significantly more likely to explain the fallacy in the God task than the marriage task ($t(167) = 2.112, p = .036$).

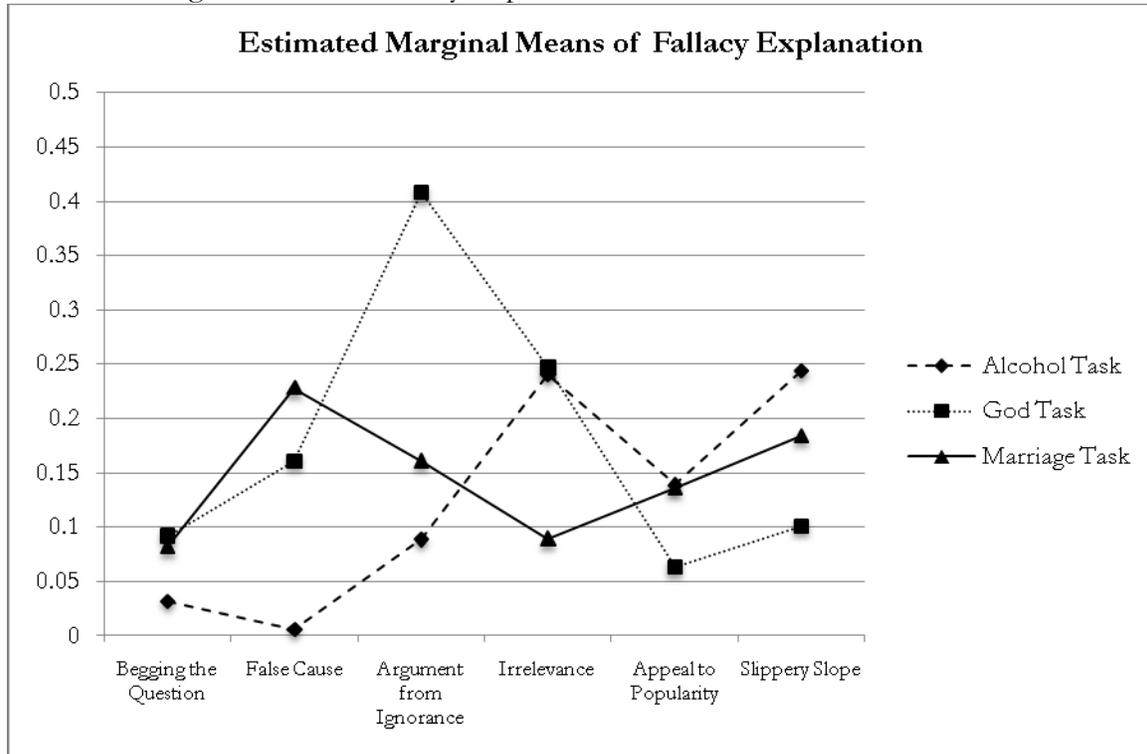
Research Question 3: Do individuals vary in their performance on informal logical fallacies across fallacies?

The hypothesis that participants will differ on their ability to explain informal logical fallacies based on the informal fallacy type (i.e., Appeal to Popularity, Argument from Ignorance, Begging the Question, False Cause, Irrelevance, and Slippery Slope) was tested by information collected from these participants. Firstly, the participants' explanation scores for each fallacy was summed across topic, in order to determine a total score for each fallacy for each participant. Secondly, participants' scores were analyzed using a doubly multivariate repeated analysis of variance (ANOVA) in order to determine if individuals differed on the ability to explain informal logical fallacies based on fallacy type. Thirdly, the doubly multivariate repeated analysis of variance (ANOVA) was used to determine if there was an interaction between the fallacy type variable and fallacy topic variable. Table 16 presents the doubly multivariate repeated analysis of variance (ANOVA) results for scores for explaining fallacies based on fallacy type and task.

Participants significantly differed on their ability to explain informal logical fallacies based on the informal fallacy type (i.e., Appeal to Popularity, Argument from Ignorance, Begging the Question, False Cause, Irrelevance, and Slippery Slope) ($F(5,785) = 18.927, p < .001, \text{partial } \eta^2 = .108$), and based on topic (i.e., the alcohol task, the God task, and the marriage task) ($F(2,314) = 8.172, p < .001, \text{partial } \eta^2 = .049$), and there was a significant interaction between these two variables ($F(10,1570) = 22.067, p < .001, \text{partial } \eta^2 = .123$).

These tests were followed up with paired-sample t-tests in order to determine the differences between variables.

Figure 3
Estimated Marginal Means of Fallacy Explanation



For the “begging the question” fallacy, participants were significantly more likely to identify the fallacy in the God task than the alcohol task ($t(157) = 2.898, p = .004$), and identify the fallacy in the marriage task than the alcohol task ($t(167) = 2.161, p = .032$). There was no significant difference between the marriage task and God task groups. For the “false cause” fallacy, participants were significantly more likely to identify the fallacy in the God task than the alcohol task ($t(167) = 6.377, p = .000$), and in the marriage task than the alcohol task ($t(167) = 7.618, p = .000$), and in the marriage task than the God task ($t(167) = 1.982, p = .049$). For the “argument from ignorance” fallacy, participants were significantly more likely to identify the fallacy in the God task than the alcohol task ($t(167) = 7.578, p =$

.000), identify the fallacy in the marriage task than the alcohol task ($t(167) = 2.572, p = .011$), and in the God task than the marriage task ($t(167) = 6.152, p = .000$). For the “irrelevance” task, participants were significantly more likely to identify the fallacy in the alcohol task than the marriage task ($t(167) = 4.643, p = .000$), and identify the fallacy in the God task than the marriage task ($t(167) = 4.560, p = .000$). There was no significant difference between the alcohol task and God task. For the “appeal to popularity” task, participants were significantly more likely to identify the fallacy in the alcohol task than the God task ($t(167) = 2.018, p = .045$), and were significantly more likely to identify the fallacy in the marriage task than the God task ($t(167) = 2.181, p = .031$). There was no significant difference between the alcohol task and the marriage task. For the “slippery slope” fallacy, participants were significantly more likely to identify the fallacy in the alcohol task than the God task ($t(157) = 4.724, p = .000$), and were significantly more likely to identify the fallacy in the marriage task than the God task ($t(157) = 2.767, p = .006$). There was no significant difference between the alcohol task and the marriage task.

Research Question 4: Does individual performance on the informal logical fallacies task predict performance on the formal logical fallacies task?

Participants completed a formal fallacy measure, which assessed their ability to overcome belief bias in sixteen logical syllogisms. It was hypothesized that participant score on the logical syllogism task will be a predictor of the ability to explain informal logical fallacies. Table 18 presents the Pearson correlations for scores on the formal fallacy syllogism measures and scores for informal fallacy explanation.

Table 18

Pearson Correlations for Scores for
Formal Fallacy Syllogisms and
Informal Fallacy Explanation

	r
Alcohol Task	.311*
God Task	.405*
Marriage Task	.290*

* $p < .001$

The Pearson correlations for scores for the formal fallacy syllogisms task and informal fallacy explanation task was found to be significant in the alcohol task, $r(165) = .311, p < .001$, the God task, $r(165) = .405, p < .001$, and the marriage task, $r(165) = .290, p < .001$.

Research Question 5: Is agreement with the protagonist's position related to performance on the informal logical fallacies task?

Participants were asked to rate, on a seven-point Likert-type scale, their agreement with each of the fallacy tasks: agreement with lowering the legal drinking age to 18 (alcohol task), the existence of God (God task), and same-sex couples having equal rights to marriage (marriage task). It was hypothesized that agreement with the task position would predict the ability of participants to explain informal logical fallacies. Table 19 presents the linear regression for agreement with task position and scores for informal fallacy explanation.

Table 19

Pearson Correlations for Agreement
with Task Position and Informal
Fallacy Explanation

	r
Alcohol Task	.083
God Task	-.117
Marriage Task	.294*

* $p < .001$

The Pearson correlations for agreement with task position was found to be significant in the marriage task, $r(165) = .294, p < .001$. The Pearson correlation on the alcohol task and God task were found to be non-significant.

Participants were asked to rate, on a seven-point Likert-type scale, their perceived intention to implement their attitudes, which in this case was to join a group that advocated the participants' position, with each of the fallacy tasks: agreement with lowering the legal drinking age to 18 (alcohol task), the existence of God (God task), and same-sex couples having equal rights to marriage (marriage task). It was hypothesized that willingness to join a group that advocated their position would predict the ability of participants to explain informal logical fallacies. Table 20 presents the Pearson correlations for implementation of attitudes with task position and scores for informal fallacy explanation.

Table 20
Pearson Correlations for Implementation
of Attitudes with Task Position and
Informal Fallacy Explanation

	r
Alcohol Task	-.082
God Task	-.206*
Marriage Task	.242*

* $p < .01$

The Pearson correlations for implementation of attitudes with task position was found to be significant in the God task, $r(165) = -.206, p < .01$, and the marriage task, $r(166) = .242, p < .01$. The Pearson correlation on the alcohol task was found to be non-significant.

Research Question 6: Do any of the demographic variables predict performance on the informal logical fallacies task?

Participants were asked to provide demographics information following the completion of the study measures. Participants were asked to provide their gender, age, race, academic major, academic year, grade point average, highest parent level of education, and estimated family income. None of the demographic variables significantly predicted participant ability to explain the sum of informal logical fallacies across the three topics. When the demographic variables were entered individually as between-subject factors in the doubly multivariate repeated analysis of variance, one demographic variable was significant. Participants significantly differed on the fallacy type by academic year ($F(20,765) = 1.751, p < .05, \text{partial } \eta^2 = .015$). Due to low participant numbers in the Freshman, Sophomore, and Other categories of academic year, these variables were computed into a new variable. The difference by academic year was found to be non-significant when the Junior, Senior, and Other variable were computed.

Research Question 7: Do prior attitudes and beliefs, demographic information, or formal logical fallacy identification best predict performance on the informal logical fallacy task?

In order to assess the model of the best predictors for one's ability to explain informal logical fallacies, the variables agreement with the position, willingness to implement beliefs, the combined attitude measures, and the scores on the formal logical syllogisms were placed into a linear regression. Table 21 presents a model for the predictor variables in the ability to explain informal logical fallacies.

Table 21
 Predictor Variables for Explaining Informal Logical Fallacies

	<i>Alcohol Task</i>		<i>God Task</i>		<i>Marriage Task</i>	
	Beta	t	Beta	t	Beta	t
Agreement	.156	1.533	-.079	-.770	.163	1.593
Implement	-.200	-1.924	-.212	-2.309*	.046	.438
Subjective Judgments Combined	.073	.712	.172	1.411	.120	1.043
Cognitive Judgments Combined	-.018	-.170	.054	.516	-.067	-.625
Formal Logic Syllogism Score	.296	3.890***	.385	5.265***	.224	2.922**

*p < .05

**p < .01

***p < .001

The linear regression for predictor variables for explaining informal logical fallacies was significant for the alcohol task ($F(5,158) = 4.279$, $p = .001$, adjusted $R^2 = .091$), the God task ($F(5,158) = 8.686$, $p = .000$, adjusted $R^2 = .191$), and the marriage task ($F(5,160) = 5.159$, $p = .000$, adjusted $R^2 = .112$). Within the full-scale linear regression for the single and combined measures of attitude strength and fallacy explanation (Table 16), attitude Importance, Intensity, and Certainty loaded differently across tasks (i.e., either positively correlated or negatively correlated with performance) for Subjective Judgments Combined, and attitude Frequency and Knowledge loaded differently across tasks (i.e., either positive correlated or negatively correlated with performance). Since the individual attitude strength variables loaded differently within this research than previous research, this difference in

loading may be masking significant variables in the regression when combined in the Subjective Judgments Combined and the Cognitive Judgments Combined. For this reason, this analysis was also run with the individual attitude strength variables for Subjective Judgments Combined (i.e., Importance, Intensity, and Certainty) and Cognitive Judgments Combined (i.e., Frequency and Knowledge). Table 22 presents a model for the best predictors for informal fallacy explanation with the single attitude strength variables.

Table 22
 Predictor Variables With Single Attitude Strength Variables for Explaining Informal Logical Fallacies

	<i>Alcohol Task</i>		<i>God Task</i>		<i>Marriage Task</i>	
	Beta	t	Beta	t	Beta	t
Agreement	.117	1.063	-.095	-.906	.200	1.860
Implement	-.200	-1.897	-.228	-2.449*	.051	.472
Importance	-.093	-.603	.142	1.018	.216	1.601
Intensity	.175	1.051	-.159	-1.077	-.055	-.330
Certainty	-.009	-.084	.212	1.689	-.009	-.070
Frequency	.081	.707	.062	.627	-.129	-1.119
Knowledge	-.086	-.872	.029	.275	.010	.111
Formal Logic Syllogism Score	.285	3.685**	.354	4.680**	.238	3.068**

*p < .05

**p < .01

The linear regression for predictor variables with single attitude strength variables for explaining informal logical fallacies was significant for the alcohol task ($F(8,155) = 2.902$, $p = .005$, adjusted $R^2 = .085$), the God task ($F(8,155) = 5.773$, $p = .000$, adjusted $R^2 = .190$), and the marriage task ($F(8,157) = 3.510$, $p = .001$, adjusted $R^2 = .108$).

CHAPTER 5

DISCUSSION

The purpose of this study was to attempt to answer several questions regarding the rejection and explanation of informal logical fallacies. First, does attitude strength have an influence on whether individuals could identify and reject informal logical fallacies? Second, does attitude strength have an influence on whether individuals could explain what was wrong with the reasoning in the argument using the informal fallacy explanation task? Third, would agreement with the argument position, or prior beliefs about the topic, have an effect on participants' ability to identify and explain informal logical fallacies, or do myside biases have an effect on the identification and explanation of informal logical fallacies? Fourth, would willingness to implement one's beliefs have an effect on one's ability to identify and explain informal logical fallacies? Fifth, are participants who correctly identify and explain one informal logical fallacy more likely to identify and explain the same fallacy across topics? Sixth, does one's ability to identify and explain one fallacy increase the likelihood of explaining one or more of the other fallacies? Finally, can the dual-processing model of cognition explain one's ability to identify and explain informal logical fallacies, and if so, does this process occur across topics?

Results from this study demonstrate that many individuals have significant difficulty identifying and rejecting informal logical fallacies. Specifically, participants in this study were able to identify 55.56% of the presented fallacies significantly better than chance, 27.78% were identified no better than chance would predict, and 16.67% were significantly worse than chance would predict. This study provides additional evidence that intelligent individuals fail to reason logically on relatively simple problems (Thompson, 2004), and

provides similar results to Kuhn (2001), in that about half of individuals fail to successfully engage in argumentation with informal reasoning. While other research has found similar results for fallacy identification (Weinstock, Neuman, & Tabak, 2004), the participants had significantly more difficulty explaining why the argument was fallacious than previous studies. For example, Weinstock, Neuman, and Tabak (2004) reported participant ability to identify informal fallacies at 62% and able to explain fallacies at 38%. Participants in this study were able to identify informal fallacies in approximately 56% of the cases and explain fallacies in approximately 17% of the cases. The difference in the ability to identify and explain informal logical fallacies in this study may be due to the difference in task presentation (i.e., multiple fallacies were addressed in each task), or in the degree of difficulty of the fallacies in this study when compared with previous studies. Furthermore, there is evidence to suggest that participants hold appropriate argumentation norms, and are able to reject the vast majority of informal logical fallacies in previous studies (Neuman, Glassner, & Weinstock, 2004). This difference may be due to the fact that the difficulty of informal fallacies can vary based on the argument being presented. Since informal logical fallacies can vary in degree of difficulty, and to date, no research has been published on a standardized set of fallacies, these differences may be explained by the degree of difficulty of fallacy presentation within an argumentation task.

Previous studies have identified several variables that accurately predict one's ability to identify informal reasoning fallacies. According to previous research, the ability to understand the deep structure of the text (Neuman, 2003), prior understanding of argumentation norms (Weinstock, Neuman, & Tabak, 2004), the perceived argument's truth-value (Neuman, Glasner, & Weinstock, 2004), and familiarity with critical discussion norms and formal debate norms (Ricco, 2007), ability to overcome belief bias in formal syllogisms

(Ricco, 2007), and complex epistemological beliefs (Ricco, 2007), were all significant predictors of the ability to identify informal logical fallacies. This study demonstrated that the attitude variables of importance, intensity, certainty, frequency, and knowledge are not strong predictors of the ability to reject informal fallacy identification for these fallacy tasks. Previous research has not addressed attitude strength variables as predictors for the ability to identify and explain informal logical fallacies. Of the three tasks (i.e., the alcohol task, the God task, the marriage task), marriage was the only task variable significantly predicted by individual attitude variables. Within the marriage task, the participants' certainty about their attitudes towards same-sex couple having equal rights to marriage and the frequency of which they thought about this issue were significant. Furthermore, these attitude measures were both positively correlated with the ability to identify informal logical fallacies. Confirmation bias would predict that, as one's beliefs become certain, one would be inclined to confirm preconceptions and avoid information that contradicts prior held beliefs. Since the questions addressed in this study deal with the hypothetical students arguing both sides of the controversial topic, attitude certainty in this study may not be the best predictor of confirmation biases. Additionally, the participants' perceived frequency in which they thought about the issue of same-sex couples having equal rights to marriage as heterosexual couples significantly predicted the ability to reject informal logical fallacies. Participants stated that they had the highest degree of certainty about their attitudes towards same-sex couples having equal rights to marriage, but they rated their perceived frequency in which they thought about the issue as relatively low.

When assessing the predictor variables of the attitude strength variables, in combination, results were again significant only with respect to the marriage task. Within the marriage task, individual subjective judgments, which included attitude importance, intensity,

and certainty, were found to significantly predict the ability to identify informal logical fallacies. Similarly, the attitude variables were not strong predictors of the ability to explain informal fallacies for the fallacy tasks. For the single attitude variables, none of the variables significantly predicted performance in any of the fallacy explanation measures across the three tasks. For the combined attitude variables, the results indicated that the variables significantly predicted only the marriage tasks scores. For this task, one's subjective judgment scores regarding same-sex couples having equal rights to marriage was the only predictor. These results suggest that attitude strength variables for the topics used in this study are not strongly related to one's ability to identify and explain informal logical fallacies. Therefore, the hypothesis that attitude strength will have a significant effect on the identification and explanation of informal logical fallacies was rejected in this study.

In addition to the attitude strength variables assessed in this study, participants were also asked to rate, on a seven-point Likert-type scale, how much they agreed with each of the task positions (i.e., that the legal limit for drinking alcohol should be lowered to 18 years of age, the existence of God, and whether same-sex couples should have equal rights to marriage as heterosexual couples). In this study, agreement with the task position was shown to significantly predict fallacy identification for the God task and marriage task, although fallacy identification was negatively correlated with agreement for the God task and positively correlated with the marriage task. As with previous studies addressing prior held beliefs regarding the topics and one's ability to reason informally with a topic (Neuman, 2003; Neuman, Glasner, & Weinstock, 2004; Neuman & Weizman, 2003; Stanovich & West, 1997; Toplak & Stanovich, 2003), the results in this study are mixed. In the current study, agreement with the task position was found to significantly hinder participant's ability to identify informal logical fallacies in the God task and, help participants identify informal

logical fallacies in the marriage task. For informal fallacy explanation, agreement with the task position was found to significantly predict performance on the marriage task, but not on the God task or alcohol task. In the informal fallacy explanation task, agreement with the issue that same-sex couples should have equal rights to marriage was positively correlated with the ability to explain informal logical fallacies. When assessing for agreement between tasks, participant agreement was found to be significantly stronger in the God task than in the marriage task, and significantly stronger in the marriage task than the alcohol task. In Neuman (2003), agreement with the statement “God exists,” was shown to have a significant effect on the “argument from ignorance” fallacy, but this effect was not replicated in the other five fallacies. Although Neuman (2003) does not speculate as to the reason that agreement with the position was significantly correlated with the inability to reject the informal reason fallacy relating to God, but this study provides some evidence that it may be the actual topic of God in which individuals experience a degree of myside bias.

Interestingly, while it can be argued that the other two topics (e.g., lowering the legal drinking age and the rights of same-sex couple to have equal marriage rights) can be argued as political issues and based primarily on opinion, the belief in the existence of the supernatural is instead taken on faith. Previous research by Weinstock, Neuman, and Tabak (2004) and Ricco (2007) have investigated the degree that epistemological norms affect the identification and explanation of informal logical fallacies. Both studies identified familiarity with argument norms as a predictor for identifying and explaining informal logical fallacies, and Ricco (2007) found that epistemological belief, or the belief about the nature of learning and knowledge, and predicted the identification and explanation of informal logical fallacies. Therefore, arguments dealing with an understanding of learning and knowledge that is faith-based may produce different results on informal logical fallacies than those dealing with

political or ideological beliefs. This study's support for myside bias, or a form of confirmation bias where an individual is only likely to generate valid arguments for one side of a controversial socially relevant topic (Perkins, 1989), is mixed. Within the God task, this study provides some support for myside bias, since individuals were significantly more likely to incorrectly identify informal logical fallacies when they agree significantly with the task. Within the marriage task, the agreement with the topic was correlated with an improved ability to identify and explain informal logical fallacies. Agreement with the alcohol task did not significantly affect the participants' ability to identify and explain informal logical fallacies.

According to previous research, individuals who have an implemental mind-set regarding an issue, or those who are in the process of acting upon their attitudes, are much more likely to adopt a one-sided position towards that issue (Henderson, de Liver, & Gollwitzer, 2008). Therefore, this research investigated whether individuals' willingness to act upon their beliefs, which in this case was join a group that advocated their position towards an issues, would affect the ability to identify and explain informal logical fallacies. As with the agreement task, scores on the implemental task are mixed. Participant perceived willingness to implement their beliefs significantly predicted the ability to identify informal logical fallacies in both the God task and the marriage task, but not in the alcohol task. As with the agreement with the topic, willingness to implement one's beliefs by joining a group advocating the position in the God task was negatively correlated with the ability to reject informal logical fallacies, while willingness to implement one's beliefs by joining a group advocating the position in the marriage task was positively correlated with the ability to reject informal logical fallacies. Similarly, on participant perceived willingness to implement their beliefs significantly predicted the ability to explain informal logical fallacies in the God task

and the marriage task, but not in the alcohol task. As with the identification task, participant's implement score on the God task was negatively correlated with the ability to reject informal logical fallacies, and in the marriage task, was positively correlated with the ability to reject informal logical fallacies. The implemental category provides additional evidence in this study that myside biases be affected in different ways and may vary depending on the task. Therefore, additional evidence is needed in order to confirm whether myside biases have a significant effect on the identification and explanation of informal logical fallacies.

Using the data collected in this study, a model to predict the ability to identify and explain informal logical fallacies was proposed. One of the strongest predictors of the ability to identify and explain informal logical fallacies was the participants' formal logical syllogism score, yet this variable accounted for only a modest amount of the variance. While some research has supported the idea that performance on informal logical fallacies correlates with one's ability to identify formal reasoning fallacies (Ricco, 2007), other studies have failed to demonstrate this result (Ricco, 2003; Neuman, 2004). As with previous studies (Ricco, 2007), scores on the formal logical syllogism task in this study were a strong predictor for the participants' ability to identify and explain informal logical fallacies. Furthermore, this effect was seen across all three tasks in both the informal fallacy identification and informal fallacy explanation. Within the model for fallacy identification, subjective judgments was also positively correlated with the alcohol task, willingness to implement one's beliefs in the God task was negatively correlated with identifying informal logical fallacies in the God task, and agreement with the position was positively correlated with the marriage task. In the model for fallacy identification, willingness to implement one's beliefs in the God task was negatively correlated with explaining informal logical fallacies in the God task.

The demographic variables assessed in this study were not a good predictor of the ability to identify and explain informal logical fallacies. Results indicated that the demographic variables were only a significant predictor for the sum of informal fallacy identification in the marriage task and produced a model with grade point average and family income were significantly positively correlated with ability to identify fallacies. The demographic variables were not significant predictors for the alcohol task and the God task for the sum of informal fallacy identification and were not significant predictors for the ability to explain any of the informal logical fallacies across tasks. When the demographic variables were entered individually as between-subject factors in the doubly multivariate repeated analysis of variance, males tended to perform better than females across topics, but not fallacy tasks. A similar trend was found for participant ethnicity, in that groups performed better on fallacy topics, but not the fallacy identification or explanation tasks. This means that the fallacy topics selected (i.e., the alcohol task, the God task, and the marriage task) may have a degree of cultural-loading, but that participant ethnicity does not play a significant role in the identification and explanation of informal logical fallacies. Finally, participants appeared to answer across fallacy topics in a more consistent basis as their grade point averages improved.

This study attempted to understand if participants would be more likely to identify and explain the same informal logical fallacy across topics if they were able to correctly identify and explain the fallacy in one topic. The results in this study were mixed. In the doubly multivariate repeated measures analysis of variance, there was a main effect found for the task, indicating that participants' scores varied significantly depending on the task. For example, in the "begging the question" fallacy, participants' scores significantly differed on the alcohol and marriage task, and the God and marriage task, but were not significantly

different when comparing the alcohol and God task. If participants were consistently able to identify the same fallacy across tasks, one would expect to find none or few significant differences across tasks for the informal logical fallacies. The trend of significant differences between tasks occurs each of the informal logical fallacies. Therefore, the null hypothesis is accepted when assessing whether individuals would be more likely to identify and explain the same fallacy across topics for this study. Furthermore, this study attempted to understand if participants who correctly identified and explained one informal logical fallacy were significantly more likely to identify and explain additional fallacies. Using a doubly multivariate repeated measure analysis of variance, it was found that there was a main effect for informal logical fallacy identification, indicating that participant scores were significantly different across fallacies. This indicates that the participants' ability to identify and explain one logical fallacy does not necessarily increase the likelihood that the individual will be able to identify another fallacy. In a visual analysis of the estimated marginal means of fallacy identification (Figure 2) and the estimated marginal means of fallacy explanation (Figure 3), one can see that fallacy scores vary widely within each task. Furthermore, for the informal fallacy identification, participants varied on their ability to identify informal logical fallacies at a rate better than chance would predict. As stated previously, due to the lack of a standardized measure for assessing participant ability to identify and explain informal logical fallacies, the difference in performance across fallacy may be due to the difficulty of fallacy presentation.

Finally, this study attempted to understand if the dual-processing model could be used to help explain individual ability to reject informal logical fallacies. At this time, the results of this study are inconclusive and need additional data to determine whether the dual-processing model has an effect on informal logical fallacies, but the results suggest that the

dual-processing model as not the main effect driving the ability to recognize and evaluate informal fallacies. According to the dual-processing theory, it was hypothesized that prior beliefs and attitudes will not affect the performance on informal logical fallacies tasks and formal logical fallacies tasks equally. Attitudes and prior beliefs about a topic have been demonstrated to have a significant effect on the evaluation of formal syllogisms. Attitudes towards a topic and prior beliefs about a topic were not shown to have a significant effect on informal logical fallacies across fallacy topics. According to the dual-processing model, when beliefs are consistent with a presented fallacy in formal logical fallacy, the heuristic system interferes with processing and the individual is more likely to accept the fallacy. Belief is automatically processed in the heuristic system in dual-processing theory, and therefore will interfere with ability to recognize the fallacy. Within the context of this study, although agreement regarding the God topic was significantly negatively correlated with the ability to reject informal logical fallacies, that is providing evidence for belief bias in informal logical fallacies, agreement with the marriage task was shown to be *positively* correlated with the ability to identify and explain informal logical fallacies. Difficulty with formal logical fallacies should show up as an error in analytical reasoning, since formal fallacies can be recognized based solely on the structure of the argument; the information presented in the formal logical fallacy is irrelevant.

Within the dual-processing theory, informal logical fallacies appeared as categorically different than formal logical fallacies. In informal logic, the individual is forced to examine the information presented in the statement and the structure of the statement and then relate it to their prior opinions and attitudes about the topic. Therefore, although attitudes and prior opinions may interfere with correctly identifying the fallacy, the acceptance of the fallacy is a matter of motivated reasoning bias or self-deception instead of an error in

analytical reasoning. Although occurring infrequently, this motivated reasoning or self-deception was demonstrated in the fallacy explanation task of several of the participants. At times, participants reacted to and responded to parts of the argument in the informal logical fallacy measure that did not specifically address the fallacy in question. For example, participants would, at times, provide their own opinions on the topic instead of explaining what was wrong with the hypothetical student's position. Occasionally, participants would use the fallacy explanation task to explain their own attitudes and beliefs towards their own understanding of God or of whether same-sex individuals should have an equal right to marriage as heterosexual couples. Informal reasoning fallacies showed up as an error in judgment.

The dual-processing theory would also predict one's inability to recognize the same informal logical fallacies across topics, or at least decrease the chance of an individual recognizing the structure of the informal reasoning fallacy as valid. The informal fallacies were not accepted based on attitudes strength towards a topic, and only marginally on agreement with the issue. Furthermore, identification and explanation was not significantly affected by the structure of the individual fallacy itself, since participant scores were significantly different across topics. As hypothesized in the dual-processing model, recognizing the structure of the fallacy had less of an effect on acceptance of the fallacy than prior attitudes towards the topic.

It was hypothesized that ability to reject an informal logical fallacy (based on content) should be moderately positively correlated with one's ability to reject a formal logical fallacy (based on structure), but that the ability to reject a formal logical fallacy would not be the best predictor of the ability to reject an informal logical fallacy. This study demonstrated, that with the predictor variables assessed in this study, formal logical

syllogism scores were the best predictor of the ability to reject informal logical fallacies. The dual-process model predicts that belief bias would have a strong influence on the evaluation of formal logical fallacies, through the automatic processes of System 1, when the belief and validity of the syllogism are in conflict. In informal logical fallacies, although prior beliefs may have had an effect on the evaluation of the fallacy, it was hypothesized that System 2 is activated to account for the informal reasoning (i.e., there is no logical syllogism for System 1 to influence). Since attitude strengths and prior beliefs were poor predictors of the ability to identify and reject informal logical fallacies, it can be assumed that System 2 accounted for the ability to reason with the arguments.

Research Limitations

The following are conceptual and methodological limitations of this study that posed threats to external and internal validity:

1) The participants in this study cannot be considered a representative sample of all university students. The sample used in this study was comprised of students from Summer Session I and II classes. The participants were primarily from junior (41.7%) and senior (42.3%) class years, and therefore are primarily representative of university students who have completed at least two years of university classes. Furthermore, the racial and ethnic demographics of this study do not match university published student demographics. It can also be assumed that the demographics of the university change during Summer Session I and II classes, as well as the types of courses being offered during this time, further shifting the demographic when comparing this sample to the student body. Any statements made regarding the generalizability of the present results beyond this sample should be made with caution.

2) While there exists a basic framework for what constitutes an informal reasoning fallacy, there is no current agreement on the structure or number of potential fallacies. Furthermore, some informal logical fallacies are considered subtypes of other fallacies, and can go by different names (e.g., the red herring fallacy is also a form of the irrelevance fallacy).

Therefore, the definition and difficulty of the same type of fallacy can vary widely. That is, the fallacy may be subtly located within the fallacy (e.g., the false cause argument in the alcohol task), or may be more easily identifiable (e.g., the argument from ignorance in the God task). More specifically, within the present field of research, there is no agreement on which informal logical fallacies to assess. Although agreement of 96% was obtained between three graduate raters for the fallacies under measure, it is possible that other expert raters may have categorized the current fallacies in different topics, or changed the arguments to better reflect just the fallacious argument.

3) This study replicated a variation of the informal fallacy identification task developed by Neuman & Weizman (2003), and used successfully in several studies (Neuman, Glasner, & Weinstock, 2004; Neuman et al., 2006; Neuman, 2003; Weinstock, Neuman, & Glasner, 2006; Weinstock, Neuman, & Tabak, 2004; Ricco, 2007), and was adapted for this study in some respects from the standard version developed by Neuman & Weizman (2003). This was the first study that attempted to assess the same fallacies across topics, which at times, produced arguments for the fallacy topics that, at face value, varied in difficulty due needing to retrofit the fallacious argument into the topic. Furthermore, this variation in difficulty was also demonstrated by the One-Sample T-Test for Informal Fallacy Identification, where participants varied in their ability to identify informal logical fallacies at a rate greater than chance.

4) At times, participants reacted to and responded to parts of the argument in the informal logical fallacy measure that did not specifically address the fallacy in question. For example, participants would, at times, provide their own opinions on the topic instead of explaining what was wrong with the hypothetical student's position. Furthermore, at times, participants reacted and responded to the specific phrasing of the argument (e.g., in the "begging the question" fallacy in the alcohol topic, several students responded, "eighteen-year-olds don't deserve it" instead of focusing on the intended "begging the question" fallacy. By standardizing a protocol, or having participants chose from a forced-choice set of responses, participants may be less hindered by the specific language of the fallacy and better able to identify and explain the fallacy in reasoning.

5) The large group administration may have influenced results on this study. Participants took a variable amount of time to complete this study, but were generally finished in twenty to forty minutes. Qualitatively, with the open response informal fallacy explanation task, some participants wrote several words for a response, while other participants filled in more than all of the line spacing provided for a response.

Practical Implications for School Psychologists

Psychologists, specifically those interesting in developing reasoning skills in school, may find the information presented in this study to be of practical use in their work with students and coworkers. In light of the limitations listed above, the results of this study for the practice of school psychology are presented:

1) Students vary widely on their ability to identify, explain, and reason with logically invalid arguments. As this study has demonstrated that even college-level students have a difficult time in understanding what makes an argument fallacious. Although poor reasoning skills do

not always lead to poor outcomes, those who reason poorly at a task and use questionable judgment are at a significant risk to do so. Therefore, schools should foster the development of reasoning skills as part of an academic curriculum. Furthermore, previous studies have suggested that college-age students can make substantial gains in reasoning skills following a single course on critical thinking (van Gelder, Bissett, & Cummings, 2004).

2) School psychologists, as well as other professionals in the field of education, should note that a large portion of college-age students, and potentially adults, have a lot of difficulty identifying informal reasoning fallacies, and even more difficulty in accurately explaining why an argument is fallacious. As school psychologists have many opportunities to be involved in argumentation throughout the school day (e.g., IEP meetings, counseling with individuals, discussions for intervention selection), school psychologists should be vigilant in attempting to understand if reasoning that they are providing is valid. School psychologists should foster the skills and abilities of reason assessment, meaning reason that can be offered in support of beliefs, claims, and judgments (Siegel, 1995), especially when making educational decisions for a child.

3) Although agreement with a topic has demonstrated confirmation bias in other forms of argumentation, this study found that agreement with a topic and attitudes towards that topic are generally relatively weak predictors of the ability to reason with informal logical fallacies. This is important, since researchers have discussed the importance regarding the empirical method as a reliable source of knowledge, irrespective of prior beliefs and individual biases (Greenhoot, et al., 2004).

Suggestions for Future Research

The present study represents an exploratory study and initial attempts to identify additional factors that predict one's ability to identify and explain informal reasoning fallacies. This study also represented an attempt to evaluate the same fallacies across topics in order to assess whether identification and explanation of one fallacy could help predict the identification and explanation of another fallacy. The following are suggestions for further research which expand upon the results of this study:

- 1) The present study could be replicated using a sample, which better represents the university population. This would mean including students selected randomly from the courses offered at the university at different times of the year. This would also mean including more freshmen and sophomore students and expanding the number of minority students.
- 2) Since previous studies have used a variety of topics upon which to base the informal fallacies, the present study attempted to provide relevant topics on which to base the informal fallacies. The present study attempted to utilize controversial situations that would have a significant impact on the participant's life, in order to determine whether any form of confirmation biases occurred when comparing fallacy identification and explanation to attitudes. Although this study used a small focus group of undergraduate students, and included conversations with graduate students and professors, it is possible that there are significant issues affecting university students that would produce different results when assessed as a topic for informal reasoning.
- 3) Although the format of the informal fallacy identification task developed by Neuman and Weizman (2003) has been used successfully in several studies (Neuman, Glasner, & Weinstock, 2004; Neuman et al., 2006; Neuman, 2003; Weinstock, Neuman, & Glasner,

2006; Weinstock, Neuman, & Tabak, 2004; Ricco, 2007), there is no formalized assessment developed that currently measures reasoning ability and specifically ability to identify and reject informal fallacies. Future research can focus on the standardization and publication of an informal fallacy task. Additionally, since some participants used the informal fallacy explanation task in order to explain their personal attitudes and beliefs regarding an issue, a forced-choice set of responses for a fallacy explanation task may provide better evidence for whether individuals are able to accurately explain what is incorrect about an informal logical fallacy.

4) Future research could focus on testing Stanovich's (2009) tripartite framework for the rejection of informal reasoning fallacies. Specifically, one could measure if individual differences in fluid intelligence in the algorithmic mind have a significant impact on the reflective mind in informal logical fallacies, and the relative influences on System 2 in the dual-processing framework. This could be accomplished by the addition of a measure of fluid reasoning (*gf*) in subsequent research involving informal logical fallacies.

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APPENDIX A

INFORMAL FALLACY TASK

1. Henry and Robert are 19 year-old undergraduate political science majors.
2. During a college seminar they discuss the question: “Should the legal age-limit for drinking alcohol be lowered from 21 to 18 years of age?”
3. Henry argues that the legal limit *should be lowered* to eighteen.
4. Robert argues that the legal limit *should not be lowered* to eighteen.
5. During the discussion Henry argues:
 - h. “*The legal limit should be lowered to eighteen years of age because this is the practice in most other industrialized countries, including most countries in Europe, Latin, and South America.*” (Appeal to Popularity)
 - i. “*The legal limit should be lowered to eighteen years of age in order to teach young adults to drink safely because a recent Centers for Disease Control (CDC) study indicated that most students who drink safely were exposed to alcohol prior to 21 years old.*” (False Cause)
 - j. “*The legal limit should be lowered to eighteen years of age because young adults deserve it. Society needs to have laws that properly serve the adult population, even if people disagree on lowering the age limit for alcohol use.*” (Begging the Question)

During the discussion Robert argues:

- k. “*The legal limit should not be lowered to eighteen years of age because no one has been able to prove that not lowering the limit would result in any significant positive effects on our society.*” (Appeal from Ignorance)
- l. “*The legal limit should not be lowered to eighteen years of age because research shows that alcohol is increasingly being sold at public places, such as sporting arenas, concert events, and nightclubs.*” (Irrelevance)
- m. “*The legal limit should be lowered to eighteen years of age, since lowering the drinking age will necessarily lead to legalization of marijuana and other drugs. Soon there will be no laws to protect our youth.*” (Slippery Slope)
- n. “*The legal limit should not be lowered to eighteen years of age, since a recent National Institutes of Health (NIH) study shows that individuals who begin to drink at eighteen instead of twenty-one are more likely to have problems with alcohol abuse later in life.*” (Valid Argument)

1. Rachel and Jessica are 20 year-old undergraduate philosophy majors.
2. During a college seminar they discuss the question: “Does God exist?”
3. Rachel argues that *God does exist*.
4. Jessica argues that *God does not exist*.
5. During the discussion Rachel argues:
 - a. “*Throughout recorded history, millions of otherwise well adjusted and rational people have stepped forward and made the claim that they had first person experience with God.*” (Appeal to Popularity)

- b. *“People have been trying for years to prove that God does not exist. But no one has yet been able to prove it. Therefore, God exists.”* (Appeal from Ignorance)
- c. *“The order and magnificence of the universe is evidence of God’s creation, so therefore God exists.”* (Begging the Question)

During the discussion Jessica argues:

- d. *“The Roman Empire collapsed after instituting mandatory religious beliefs. Therefore we must avoid religious beliefs for the same reasons.”* (False Cause)
- e. *“God does not exist because think about all of the inconsistencies in any religious text. No religious text is perfect and always has human made flaws, therefore God does not exist.”* (Irrelevance)
- f. *“Belief in a God of any religion inevitably leads to certain dogmas and creeds that are incompatible with other religions. Therefore, any belief in God will lead to individuals who are prejudiced and bigoted towards others.”* (Slippery Slope)
- g. *“If science, by definition, investigates the natural world, and God is supernatural, then one cannot prove the existence or non-existence of God using science.”* (Valid Argument)

1. Lauren and William are 18-year-old undergraduate sociology majors.
2. During a college seminar, they discuss the question: “Should same-sex couples have the same legal rights to marriage as heterosexual couples?”
3. Lauren argues that they *should* have equal rights.
4. William argues that they *should not* have equal rights.
5. During the discussion, William argues:
 - a. *“Same-sex marriages should not be supported because the marriages fly in the face of cultural and traditional family life all around the world. Gay marriages are just immoral; at least seventy-five percent of the world thinks so.”* (Appeal to Popularity)
 - b. *“Legalization has shown to correlate with an increase in the number of individuals who believe something to be morally justified. If we legalize same-sex marriage, the legalization will cause a drastic increase in the number of gay individuals.”* (False Cause)
 - c. *“If we allow gay marriages then it will lead to the destruction of marriage as we know it. People will undoubtedly be able to marry as many people, whoever, and whatever they want.”* (Slippery Slope)
 - d. *“In your argument, you have not proved to me that same-sex marriages should be legalized, therefore same-sex marriages should be illegal.”* (Appeal from Ignorance)

During the discussion, Lauren argues:

- e. *“Same-sex marriages should be legalized. After all, the most loving family relationships begin with a child and two parents, regardless of the sexual orientation of the parents.”*
(Irrelevance)
- f. *“Legalized marriage should not be restricted to heterosexual couples, since if same-sex marriages were illegal they would be prohibited by the law.”* (Begging the Question)
- g. *“If one accepts that the government should not make rulings on any issues that do not further government objectives, and restricting the right of gays to marry does not further any government objectives, then the government should not make rulings on who can and cannot get married.”*
(Valid Argument)

Informal Fallacy Task: Sample Structure

Question 1

Henry and Robert are 19 year-old undergraduate political science majors.

During a college seminar they discuss the question: “Should the legal age-limit for drinking alcohol be lowered from 21 to 18 years of age?”

Henry argues that the legal limit *should be lowered* to eighteen.

Robert argues that the legal limit *should not be lowered* to eighteen.

During the discussion **Henry** argues:

“The legal limit should be lowered to eighteen years of age because young adults deserve it. Society needs to have laws that properly serve the adult population, even if people disagree on lowering the age limit for alcohol use.”

Is the reasoning in this argument faulty or problematic in any way?

Yes

No

If you believe the reasoning in this argument was faulty or problematic, please explain what you feel is wrong with the reasoning:

APPENDIX B

SCORING CRITERIA FOR THE INFORMAL FALLACY TASK

Scoring Criteria for the Informal Fallacy Task (Ricco, 2007)

Full Credit (1.0)	Part Credit (0.5)
<i>Appeal to Popularity</i> Mere fact that others accept or do something is not sufficient reason.	Argument does not provide any real reasons or evidence in support of the claim. OR Argument does not explain why popularity should be a consideration.
<i>Argument from Ignorance</i> Absence of reason against a claim is not an argument for the claim.	If you make a claim, you must provide support and this argument does not try to. OR Arguer is evading or shifting the burden of proof.
<i>False Cause</i> Correlation is not necessarily causation. OR Cannot tell whether A causes B, B causes A, or C causes A and B.	Does not explain why or how the one factor allegedly influences the other. OR The alleged cause is not sufficient or necessary for the effect.
<i>Irrelevance</i> The reason does not appear to have anything to do with the claim.	The reason does not make the claim any more likely to be true. OR The reason could be true and not the claim or vice versa.
<i>Begging the Question</i> The reason and the claim are the same or too similar.	The argument is not saying anything. OR Arguer is just stating an opinion. There is no reason being given for the claim.
<i>Slippery Slope</i> No reasons given as to why one step would lead to another.	The argument jumps to conclusions and exaggerates consequences. OR Distracts you from the matter at hand by frightening you with dire consequences.
<i>Valid Argument</i> Argument is valid.	

APPENDIX C

FORMAL LOGIC SYLLOGISM TASK

You are going to receive a series of sixteen problems. You must decide whether the stated conclusion *follows logically* from the premises or not.

You must *suppose that the premises are all true* and limit yourself only to the information contained in these premises. This is very important.

For each problem, decide if the given conclusion *follows logically from the premises*. Circle YES if, and only if, you judge that the conclusion can be derived *unequivocally* from the given premises, otherwise circle NO.

- (1) Premise 1: All things that are smoked are good for the health.
Premise 2: Cigarettes are smoked.
Conclusion: Cigarettes are good for the health.

YES

NO

- (2) Premise 1: All unemployed people are poor.
Premise 2: Rockefeller is not unemployed.
Conclusion: Rockefeller is not poor.

YES

NO

- (3) Premise 1: All flowers have petals.
Premise 2: Roses have petals.
Conclusion: Roses are flowers.

YES

NO

- (4) Premise 1: All animals with four legs are dangerous.
Premise 2: Poodles are not dangerous.
Conclusion: Poodles do not have four legs.

YES

NO

- (5) Premise 1: All mammals walk.
Premise 2: Whales are mammals.
Conclusion: Whales walk.

YES

NO

For each problem, decide if the given conclusion *follows logically from the premises*. Circle YES if, and only if, you judge that the conclusion can be derived *unequivocally* from the given premises, otherwise circle NO.

- (6) Premise 1: All eastern countries are communist.
Premise 2: Canada is not an eastern country.
Conclusion: Canada is not communist.

YES

NO

- (7) Premise 1: All animals love water.
Premise 2: Cats do not like water.
Conclusion: Cats are not animals.

YES

NO

- (8) Premise 1: All things that have a motor need oil.
Premise 2: Automobiles need oil.
Conclusion: Automobiles have motors.

YES

NO

- (9) Premise 1: Some healthy people are unhappy.
Premise 2: No unhappy people are astronauts.
Conclusion: Some healthy people are not astronauts.

YES

NO

- (10) Premise 1: No deep sea divers are smokers.
Premise 2: Some smokers are good swimmers.
Conclusion: Some good swimmers are not deep sea divers.

YES

NO

- (11) Premise 1: Some judges are lazy.
Premise 2: No lazy people are well educated.
Conclusion: Some judges are not well educated.

YES

NO

For each problem, decide if the given conclusion *follows logically from the premises*. Circle YES if, and only if, you judge that the conclusion can be derived *unequivocally* from the given premises, otherwise circle NO.

- (12) Premise 1: No religious people are healthy.
Premise 2: Some healthy people are priests.
Conclusion: Some priests are not religious.

YES

NO

- (13) Premise 1: No highly trained dogs are vicious.
Premise 2: Some vicious dogs are police dogs.
Conclusion: Some highly trained dogs are not police dogs.

YES

NO

- (14) Premise 1: Some cigarettes are inexpensive.
Premise 2: No inexpensive things are addictive.
Conclusion: Some addictive things are not cigarettes.

YES

NO

- (15) Premise 1: No millionaires are hardworkers.
Premise 2: Some hardworkers are rich people.
Conclusion: Some millionaires are not rich people.

YES

NO

- (16) Premise 1: Some nutritional things are inexpensive.
Premise 2: No inexpensive things are vitamins.
Conclusion: Some vitamins are not nutritional.

YES

NO

APPENDIX D

PERSONAL ATTITUDES TASK

The following questions are designed to understand your personal attitudes and beliefs towards the issue of:

Informal fallacy topic

Please rate your personal opinion to the following topic to the best of your ability.

1. How much do you agree with the issue of... (agreement)						
Strongly Disagree						Strongly Agree
1	2	3	4	5	6	7
2. How certain are you about your attitude toward the issue of... (certainty)						
Not at all certain						Certain
1	2	3	4	5	6	7
3. How firm in your opinion toward the issue of... (certainty)						
Not at all firm						Very firm
1	2	3	4	5	6	7
4. How intense is your attitude toward the issue of... (intensity)						
Not at all intense						Intense
1	2	3	4	5	6	7
5. How strong is your attitude toward the issue of... (intensity)						
Very weak						Very strong
1	2	3	4	5	6	7
6. How important is your attitude toward the issue of... to you personally? (importance)						
Not at all important						Important
1	2	3	4	5	6	7

The following questions are designed to understand your personal attitudes and beliefs towards the issue of:

Informal fallacy topic

Please rate your personal opinion to the following topic to the best of your ability.

**7. How much does your attitude toward the issue of... mean to you?
(importance)**

Means very little
1 2 3 4 5 6 7
Means a lot

8. How often do you think about the issue of...? (frequency)

Never
1 2 3 4 5 6 7
Frequently

9. How often do you discuss the issue of... with others? (frequency)

Never
1 2 3 4 5 6 7
Frequently

**10. How knowledgeable do you consider yourself to be about the issue of...?
(knowledge)**

Not at all knowledgeable
1 2 3 4 5 6 7
Very knowledgeable

11. How informed are you about the issue of...? (knowledge)

Not at all informed
1 2 3 4 5 6 7
Very informed

**12. How willing would you be to join a group that advocated the issue of...?
(implemental)**

Not at all willing
1 2 3 4 5 6 7
Very willing

APPENDIX E

DEMOGRAPHICS QUESTIONNAIRE

What is your sex?

- Female Male

What is your age? _____

What is your race/ethnicity? (Select as many as apply)

- African American / Black Asian and Pacific Islander
 Latino or Hispanic Native American, American Indian or Alaskan
 White Other, please specify: _____

What is your academic major(s)? _____

What is your current academic year?

- Freshman
 Sophomore
 Junior
 Senior
 Other, please specify: _____

What is your current Grade Point Average (G.P.A.)?

(If unknown, please estimate): _____

What is your highest level of parental education?

- Some high school education
 High school diploma
 Some college
 Associate degree
 Bachelor degree
 Post-graduate degree

What is your estimated family income?

- Less than \$30,000
 \$30K - 49,999
 \$50K - 74,999
 \$75K - 99,999
 \$100K or More

APPENDIX F

INFORMAL FALLACY EXPLANATIONS

Argument ad populum (appeal to the people)

Argument ad populum is a fallacy that presents that a proposition is true because all or many individuals believe it to be true.

Argument ad ignorantium (argument from ignorance)

Argument ad ignorantium is a fallacy that presents that a proposition is true because it has not been proven to be false, or conversely, is false because it has not been proven to be true. Argument ad ignorantium attempts to shift the burden of proof away from the one who is making the argument.

Argument non-causa pro causa (false cause)

Argument non-causa pro causa is a fallacy that incorrectly identifies the cause of an argument. *Post hoc ergo propter hoc* is a form of this fallacy, whereby one assumes that one event caused another event simply because the first preceded the second.

Petito principi (begging the question)

Petito principi is a fallacy where the conclusion explicitly or implicitly restates one of the argument premises. Petito principi is also known as *begging the question* or a *circular argument*.

Ignoratio elenchi (irrelevance)

Ignoratio elenchi is a fallacy where the conclusion, although potentially valid, has nothing to do with the claim of the argument.

Slippery slope

Slippery slope is a fallacy where a beginning proposition inevitably leads to a chain of related events which cause a significant outcome. This fallacy ignores the subsequent steps between the events and does not provide any reason is provided why one step would lead to another.

APPENDIX G
SCRIPT USED FOR PARTICIPANT SOLICITATION

“Thank you Professor [Professor’s Last Name] for allowing me to speak to your students. My name is Jay Tarnoff and I am currently a doctoral student in the School Psychology Department here at Temple University. I have randomly selected classes during the summer I and summer II sessions at Temple to have the opportunity to participate in my dissertation research study entitled: *An Investigation of the Role of Attitudes in the Evaluation of Informal Reasoning*. Participation in this study is completely voluntary and open to students age eighteen and older. The study takes approximately forty-five minutes to complete.

Students who are willing to participate can be entered to win one of three one-hundred dollar checks that will be randomly selected from the entire participant pool following completion of data collection. For students interested in participating in this study, please remain in your seat following the end of class and I will pass out a folder with a consent form and the study measures. Are there any questions?”

APPENDIX H
CONSENT FORM

TITLE: An Investigation of the Role of Attitudes in the Evaluation of Informal Reasoning.

INVESTIGATORS: PI: Frank Farley, Ph.D.;
Graduate Student Researcher: Jay Tarnoff, M.Ed.

DEPARTMENT: Psychological Studies in Education
College of Education
Ritter Annex 203

PHONE: (215) 204-6024

PURPOSE: The purpose of this study is to investigate how attitudes have an influence in the evaluation of logical reasoning.

PROCEDURE: If you chose to participate in this study, we ask that you remain in your seat and survey packets will be distributed to each student. These surveys will ask you to identify your attitudes towards certain topics and complete questionnaires based on arguments derived from these topics. These questionnaires will also ask you to complete a series of logical reasoning tasks and provide demographics information about yourself. It is expected that this research will take approximately 40 minutes to complete.

BENEFITS: Individuals who choose to participate in this study can be entered to win one of three gift cards valued at \$100.00. Drawings will be conducted following the completion of data collection.

RISKS/DISCOMFORT: This study is expected to expose the participant to no physical risk and minimal emotional risk. The participant may experience discomfort, in the form of boredom, as a result of participating in this study and may experience some inconvenience by volunteering his/her time to participate in this study.

CONFIDENTIALITY: The data you will provide will be recorded anonymously and your participation will be held in the strictest confidence.

SUBJECT RIGHTS: I understand that if I wish further information regarding my rights as a research subject, I may contact Richard Throm, Program Manager & Coordinator at Office of the Vice President for Research of Temple University by phoning (215) 707-8757.

QUESTIONS: We welcome questions about the experiment at any time. Your questions should be directed to the Principal Investigator, Dr. Frank Farley, Psychological Studies in Education, College of Education, Temple University, 1301 Cecil B. Moore Avenue, 203 Ritter Annex, Philadelphia, PA 19122-6091, frank.farley@temple.edu, (215) 204-6024, or you may contact the Graduate Student Researcher, Jay Tarnoff, jay.tarnoff@temple.edu, (215) 204-1740.

Signing your name below indicates that you have read and understand the contents of this Consent Form and that you agree to take part in this study.

Participant's Signature

Date

Investigator's Signature

Date

APPENDIX I

DEBRIEFING FORM

For the study entitled: “An Investigation of the Role of Confirmation Bias in the Evaluation of Informal Reasoning Fallacies”

Dear Participant;

During this study, you were asked to provide information regarding your attitudes regarding socially relevant topics. You were told that the title of this study was *An Investigation of the Role of Attitudes in the Evaluation of Informal Reasoning*. The actual title of this study was *An Investigation of the Role of Confirmation Bias in the Evaluation of Informal Reasoning Fallacies*. You were told that the purpose of the study was to investigate how attitudes have an influence in the evaluation of logical reasoning. The actual purpose of the study was to investigate whether prior beliefs and attitude strength have an influence on the acceptance or rejection of a specific type of reasoning, informal reasoning fallacies, in different argument types.

We did not tell you everything about the title and purpose of the study because of the role of confirmation bias, or the tendency to search for and interpret information in a way to confirms one’s preconceptions, in psychological research.

You are reminded that your original consent document included the following information: This experiment is expected to expose the participant to minimal physical or emotional risk. The participant may experience discomfort, in the form of boredom, as a result of participating in this experiment and may experience some inconvenience by volunteering his/her time to participate in this research. If you have any concerns about your participation or the data you provided in light of this disclosure, please discuss this with us. We will be happy to provide any information we can to help answer questions you have about this study.

If your concerns are such that you would now like to have your data withdrawn, we will do so.

If you have experiences of distress as a result of your participation in this study or if you have questions about your participation in the study, please contact the Principal Investigator, Dr. Frank Farley, Psychological Studies in Education, College of Education, Temple University, 1301 Cecil B. Moore Avenue, 213 Ritter Annex, Philadelphia, PA 19122-6091, frank.farley@temple.edu, (215) 204-6024, or you may contact the Graduate Student Researcher, Jay Tarnoff, jay.tarnoff@temple.edu, (215) 204-1740.

If you have questions about your rights as a research participant, you may contact Richard Throm, Program Manager & Coordinator at Office of the Vice President for Research of Temple University by phoning (215) 707-8757.

Please again accept our appreciation for your participation in this study.