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ABSTRACT

We examined subjects' ability to judge the soundness of informal arguments. The argument claims matched or did not match subject beliefs. In all experiments subjects indicated beliefs about spanking and television violence in a prescreening. Subjects read one-sentence arguments consisting of a claim followed by a reason and then judged the soundness of the argument. Signal detection theory analyses were used to examine discrimination performance and response bias. In Experiment 1 discrimination was not predicted by beliefs, but subjects were biased in favor of rejecting arguments as unsound when the claim was inconsistent with their beliefs compared with when it was consistent. In Experiments 2 and 3 we replicated these effects and examined neutral subjects and reasoning ability as factors. The results suggest that belief or disbelief in an argument claim biases students' judgments of the argument's soundness.

Introduction

Informal arguments are used both to persuade audiences to accept a claim and to educate audiences about claims for which they may have little knowledge. A sound informal argument consists of a claim followed by one or more supporting reasons that connect to the claim (Britt & Larson, 2003; Toulmin, 1958; Voss & Means 1991). In judging the soundness of an informal argument, students must determine whether the stated reason provides support for the claim (Larson, Britt, & Larson, 2004). In many domains across the undergraduate curriculum, analyzing informal arguments is considered to be a central skill that students should learn (Kuhn, 2010; Wolfe, 2011). However, research in which students judge the validity of informal arguments leads to the general conclusion that this task is difficult, and student performance is generally poor (Britt, Kurby, Dandotkar, & Wolfe, 2008; Larson, Britt, & Kurby, 2009; Larson et al., 2004; National Center for Education Statistics, 2010). Specifically, students have a difficult time determining whether a given reason supports a claim or whether a reason is unsupportive or irrelevant to a claim.

In the current research we are interested in the role that beliefs about argument claims may play in students' evaluation of informal arguments. In educational contexts, students arrive in classes with beliefs about topics that are studied. In psychology, for example, students have a range of prior beliefs about topics that are commonly covered in introductory courses, many of which are misconceptions (Kowalski & Taylor, 2009; Taylor & Kowalski, 2004). It is important to understand the role beliefs play in students' evaluation of arguments partly because students often maintain incorrect beliefs even after being taught correct information (Taylor & Kowalski, 2004). Considerations about whether to change beliefs may involve evaluating the quality of arguments both in support of and opposed to a person's beliefs. From a theoretical standpoint, we are interested in how people mentally represent and reason

with arguments. If holding a belief about a topic reduces the ability to reason about that topic, then it will be a major challenge in education to circumvent this issue.

Research on the comprehension and evaluation of informal arguments can be contrasted with research examining formal reasoning (Evans, Barston, & Pollard, 1983). In some research on formal reasoning, subjects analyze syllogisms in which two premises and a conclusion are given. The task is to determine if the conclusion is warranted given the premises. In a number of studies a belief bias has been found in which subjects tend to accept the conclusion as valid if it is believable (or factually true) independent of whether it can be concluded given the premises (Dube, Rotello, & Heit, 2010; Oakhill, Johnson-Laird, & Garnham, 1989; Thompson & Evans, 2012). However, Thompson and Evans (2012) found that the degree of belief bias in formal reasoning did not predict the degree of bias in informal reasoning. As a result, applying conclusions about the potential influence of beliefs in formal reasoning to informal reasoning appears unwarranted. It is important to also note that the beliefs we investigate in the current study are different from those studied in formal reasoning experiments. In those studies beliefs are investigated regarding whether a statement merely is believable (e.g., a flower is pretty). In our experiments reported here we investigate the effects of possessing a deeply held opinion about a topic. Below, we first introduce informal reasoning. Next, we describe discrimination and response bias and how beliefs about the argument topics may influence these processes. Finally, we describe our use of signal detection theory (SDT) as an analytical method for examining how beliefs may influence discrimination and response bias in informal reasoning.

Reasoning about informal arguments

People can have myriad beliefs about an informal claim (e.g., "The death penalty should be abolished.") Independent of beliefs, however, informal arguments can be evaluated on the basis of *soundness*. According to Voss and colleagues (Voss, Blais, Means, Greene, & Ahwesh, 1989; Voss & Means, 1991; Voss & Van Dyke, 2001), the soundness of an informal argument is based on three criteria. First is the acceptability of the reason (e.g., "because many innocent people are put to death."). Only reasons that are *plausible* or acceptable on their own can be used as part of a sound argument. The second criterion is the extent to which the reason supports or is *relevant* to the claim. If a reason does not support a claim or if it is irrelevant, then the argument cannot be considered sound. Third, Voss and colleagues suggest that sound arguments also take into consideration potential *counterarguments* that may arise. In the current research we are concerned with the relevance criteria. We examine one-sentence arguments with reasons that independently are acceptable or present accurate information. Also, in these short arguments counterarguments are not considered. To make the relevance judgment more concrete, consider the following sound informal arguments:

(1.1) *Spanking is an effective means of discipline because methodologically sound studies have shown that spanking reduces aggression.*

(1.2) *Spanking is an ineffective means of discipline because families who spank their children early in childhood end up having to spank them just as often late in childhood.*

Argument (1.1) is sound because the reason supports and is relevant to the claim; sound studies provide trustworthy conclusions (Toulmin, 1958). Similarly, in (1.2) the reason is relevant to and supports the claim; ineffective interventions fail to change behavior. We refer to argument (1.1) as a *pro* argument because it supports the proposition, whereas (1.2) is a *con* argument because it disputes the proposition that spanking works.

Consider the following two unsound arguments:

(1.3) *Television violence causes real violence because children who watch violent television often comment on the shows while they watch them.*

(1.4) *Television violence does not cause real violence because violent television programs contain mostly males.*

Both arguments are unsound because the reasons (e.g., children who watch violent television often comment on the shows while they watch them) are not relevant to the claims (television violence causes real violence). Commenting on a show is not diagnostic of perpetrating a crime.

Consistent with other work on argumentation, we propose that students represent the components of these arguments in an argument schema (Wolfe, 2012; Wolfe, Britt, & Butler, 2009). The argument schema is consistent with traditional work on cognitive schemas (Schank & Ableson, 1977) and contains knowledge that arguments need to have certain components that relate to each other in particular ways. The schema for the arguments we examine contains a slot for the claim, the reason, and an understanding that the claim needs to be relevant to the reason. The claims in these arguments will vary with respect to students' beliefs. These beliefs may not be related to the preponderance of scientific evidence supporting the claim. If a student believes the claim, then the claim is *belief consistent*, and if not, the claim is *belief inconsistent*. In work on argument comprehension, Voss, Fincher-Kiefer, Wiley, and Silfies (1993) provide evidence that relevant attitudes are automatically activated when students read arguments. They also suggest that after activation of attitudes, reasons associated with the claim are automatically activated. The mental representation students use to evaluate the soundness of these arguments consists of the claim and reason schema structures, along with associated knowledge, beliefs, and attitudes that are activated when reading the arguments.

When students determine whether a given reason supports a claim, we propose that the perceived relevance of a reason to a claim is not judged as all-or-none but rather that it varies on a continuum. The degree of goodness of the claim–reason match is the criteria by which students will decide if an argument is sound or not. We are interested in two questions that relate to how students' beliefs may influence this judgment process. First, does belief in the argument claim influence the process of *discriminating* sound from unsound arguments? Good discrimination performance involves making an accurate judgment about the relevance of the reason to the claim, and thus accepting sound arguments as sound and rejecting unsound arguments as unsound. Second, does belief in the argument claim influence students' overall tendency to accept or reject the soundness of arguments? Students may be more likely to judge a reason to be relevant to a claim if they believe the claim regardless of the actual relevance of the reason. This second question is one of *response bias*.

Beliefs and discrimination accuracy

How might beliefs influence discrimination accuracy? One possible mechanism is that belief consistency may influence the scrutiny that is put into evaluating arguments. In particular, reading a belief-consistent claim may change a reader's processing and potentially her evaluation of an argument. Some work in social psychology, such as research on motivated reasoning, suggests that in certain circumstances having a belief in a topic changes how one processes an argument (Ditto, Scepansky, Munro, Apanovitch, & Lockhart, 1998; Edwards & Smith, 1996; Howard-Pitney, Borgida, & Amato, 1986; Klaczynski & Robinson, 2000). For example, Klaczynski and Robinson (2000) found that belief-consistent arguments were judged to be stronger and more persuasive than belief-inconsistent arguments. They also found that readers were able to list more supporting reasons to *belief-inconsistent* arguments than belief-consistent ones. Based on these findings, Klaczynski and Robinson (2000) proposed that people are typically motivated to reason in a way that maintains their beliefs. When people read belief consistent arguments, they apply *heuristic* processing, in which reasoning is fast and relatively effortless. This low-effort reasoning is triggered by the circumstance that belief consistent arguments do not threaten the person's belief systems, so maintaining beliefs is simple. Belief inconsistent arguments are more likely to trigger *analytic* processing, which is more deliberate and effortful. Analytic processing is engaged with the goal of discounting the belief inconsistent arguments so that current beliefs can be maintained. We did not measure processing directly in the current research. But these studies suggest that a reader's ability to discriminate between sound and unsound belief-consistent arguments may be relatively low, and a reader's ability to discriminate between sound and unsound belief-inconsistent arguments may be relatively high.

Other research on argument processing and representation, however, suggests that belief consistency may not predict argument discrimination ability. Some evidence suggests that belief inconsistent information is not always processed with more scrutiny. Britt et al. (2008) found that agreement with argument claims did not predict improved memory for arguments. Wolfe, Tanner, and Taylor (2013) examined students' processing and memory of extended one-sided arguments that were belief consistent or inconsistent. Across two experiments belief consistency rarely predicted processing time for arguments or memory of argument content. Wolfe and Britt (2008) had subjects search information sources related to a topic then write an argumentative essay. They found that agreement with the topic did not predict biases in which studies were selected, nor in arguments generated in the essays. As such, it is possible that holding a belief on a topic has no impact on one's ability to evaluate the quality of arguments. There is also reason to doubt that an increase in effort during reading translates into improved processing (Kunda, 1990).

Beliefs and response bias

We also address whether subjects will show a response bias in favor of belief consistent arguments. For example, consider a subject who believes there is no causal link between television violence and real violence. Would this subject be more likely to accept sentence (1.4) as sound than sentence (1.3)? Both are unsound, but (1.4) has a belief consistent claim, whereas (1.3) has a belief inconsistent claim. The previously discussed data of Klaczynski and Robinson (2000) suggest a belief consistent response bias; subjects rated belief consistent arguments as being stronger and more persuasive. Wolfe et al. (2009) varied the claims of arguments to be consistent or inconsistent with subject beliefs. They found that agreement with the arguments was higher when subjects believed the argument claim than when they did not. Baron (1995) had subjects rate the quality of arguments about abortion. When subjects rated one-sided arguments (in which there were not counterarguments presented), quality ratings were higher when subjects agreed with the argument claim than when they did not. Stanovich and West (1997) evaluated reasoning ability using a task called the Argument Evaluation Test in which subjects read an argument, then a counterargument, then a rebuttal to the counterargument. Subjects rate the quality of the rebuttal. The quality ratings were compared with expert ratings of the rebuttal quality. Stanovich and West (1997; also Thompson and Evans, 2012) found that belief in the argument predicted subjects' ratings of argument quality. One notable characteristic of these studies is that subjects rate the strength or quality of arguments rather than their soundness. Strength and quality judgments may include other considerations, such as the plausibility of the reason (e.g., does it match the best available scientific evidence?) or the extent to which the counterargument is sufficiently addressed. It is also important for students to be able to determine the soundness of arguments independent of the multiple considerations that relate to strength. We predict that subjects will demonstrate a response bias in which they are more likely to accept both sound and unsound arguments as sound when they believe the claim compared with sound and unsound arguments in which they do not believe the claim.

Current research

In three experiments we evaluate the extent to which belief consistency between informal argument claims and subject beliefs predict discrimination accuracy and response bias. We evaluate subjects' argument evaluation performance using SDT (e.g. Swets, 1986). SDT applies to judgments in which subjects need to distinguish the presence of a signal in an environment from noise (a nonsignal) in the environment. Classic examples of SDT related tasks are determining if a light was presented or a tone was played in a perception experiment or whether a previously studied item was presented in a test during a memory experiment. The basic claim of SDT is that trials vary on a single dimension of signal strength. If a subject performs the discrimination task well, then sound arguments will elicit higher levels of relevance strength compared with unsound arguments. According to SDT, subjects will also set

		Subject 1 responses		Subject 2 responses		Subject 3 responses	
		Acceptable	Flawed	Acceptable	Flawed	Acceptable	Flawed
Argument soundness	Sound	80	20	60	40	80	20
	Unsound	40	60	20	80	0	100

Figure 1. Sample rates of percent responding "acceptable" to the question of whether a reason in an argument supports the claim of the argument. In the example, Subjects 1 and 2 have equal discrimination (equal numbers of correct and incorrect responses), with a d' score of 1.09. Subject 3 has greater discrimination, with a d' score of 2.12. Subject 1 exhibits a response bias favoring responding "acceptable," with a C score of $-.29$. Subjects 2 and 3 have a bias favoring "flawed" responses, with C scores of .29 and .22, respectively.

a decision criterion point. Arguments with a relevance strength above the criterion point will be judged to be sound, whereas arguments with a relevance strength below the criterion point will be judged as unsound. This criterion point is considered a measure of one's bias. Set too high, the reader will more frequently than not judge arguments to be unsound. Set too low, the reader will more frequently than not judge arguments to be sound.

SDT is well suited for our analysis purposes for two reasons. First, our proposal that the relevance judgment of argument soundness varies on a continuum matches the assumption of SDT that signal strength is continuous. Second, SDT affords the calculation of both discrimination and response bias measures of performance. Both measures are calculated using hit rates (HRs) and false alarm rates (FARs). The HRs for a subject refers to the proportion of the time they respond "acceptable" to arguments that are sound. The FAR is the proportion of times a subject responds "acceptable" to arguments that are unsound. The first measure is discrimination accuracy, which is described in SDT with d'. d' is calculated with the formula $d' = Z(\text{HR}) - Z(\text{FAR})$. Better than chance levels of discrimination are characterized by d' scores greater than zero and indicate that subjects responded "acceptable" to many of the sound arguments and "flawed" to many of the unsound arguments.[1] The second measure is response bias, which is characterized by C (Stanislaw & Todorov, 1999). In this task, C indicates the extent to which subjects have a general bias toward accepting arguments as sound regardless of the argument's actual soundness. C scores are calculated with the formula $C = -(Z(\text{HR}) + Z(\text{FAR}))/2$. Subjects who accept half of the arguments as sound will have a C of zero. Those who respond "acceptable" more than half the time will have negative C values, whereas those who respond "acceptable" less than half the time will have positive C values. Note that we do not claim that a C score of zero means that the subject is "unbiased," because we do not know what the base rate of responding might be for a particular subject. We interpret C scores relative to each other across conditions rather than against a fixed level of zero. SDT has been used to assess performance in the evaluation of formal arguments (Dube et al., 2010). However, as far as we are aware these experiments represent the first use of SDT to evaluate reasoning performance on informal arguments.

Figure 1 shows sample response data from three subjects to illustrate the use of d' and C in evaluating arguments. Subject 1 in Figure 1 has a HR of .8 and a FAR of .4. Notice that the subject has a response bias ($C = -.29$) such that they responded "acceptable" more than half the time. Subject 2 has the same discrimination performance ($d' = 1.09$) but a response bias ($C = .29$) that has shifted such that they responded "flawed" more than half the time. Subject 3 has approximately the same response bias as subject 2 ($C = .22$) but better discrimination performance ($d' = 2.12$), with more hits relative to the number of false alarms.

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[1]We use the terminology "sound" and "unsound" arguments in the Introduction and Discussions to refer to arguments in which the reason is relevant or is not relevant to the claim. We use "acceptable" and "flawed" to refer to actual subject responses in the task because this terminology was used in the instructions.

In these experiments subjects evaluated the soundness of arguments by judging whether the reason provided in the argument supports the claim. In a prescreening survey, subjects indicated whether they believe or disbelieve argument claims (e.g., television violence causes real violence). In the experiments subjects rated arguments about whether they are acceptable or flawed based on whether the reason is relevant to the claim. Half the arguments that subjects rated were pro arguments (they argue in favor of the claim) and half were con arguments (they dispute the claim). In the design subject beliefs are crossed with the argument claim position (pro vs. con) such that half the arguments subjects rate have belief consistent claims and half have belief inconsistent claims.

In these experiments belief consistency influences on discrimination and response bias would be revealed through an interaction between subject beliefs and argument claim position. For example, if discrimination is better for arguments with belief inconsistent claims, then d' will be larger for the belief inconsistent conditions (believers evaluating con arguments and disbelievers evaluating pro arguments) compared with the belief consistent conditions. Similarly, if subjects are biased to accept arguments as sound if the claims are belief consistent, they will have lower C scores relative to belief inconsistent C scores. That is, people will be more likely to accept arguments as sound when they believe the claim than when they do not.

In Experiment 1 we examined whether discrimination accuracy and response bias change as a function of belief consistency between subject beliefs and argument claim positions. We examined two topics, television violence and spanking. In Experiment 2 we compared belief consistent and belief inconsistent performance on these tasks to a group of subjects who do not hold polarized beliefs about the topics. In Experiment 3 we examined the extent to which our discrimination accuracy and response bias findings may vary as a function of the overall reasoning ability of subjects. In all three experiments we also examined a possible moderation effect in which response bias may vary for students with differing reasoning abilities. In particular, it is possible that students with better reasoning ability will show reduced belief-based response bias. If so, discrimination performance should moderate belief-based response bias. Finally, in all three experiments we examined the individual difference measure of topic importance. We collected a measure of topic importance modeled after Holbrook, Berent, Krosnick, Visser, and Bonninger (2005), who found that topics that were higher in importance generated greater elaboration compared with topics that were lower in importance. If argument discrimination performance is improved with greater argument elaboration, then we may find that the importance of the topic predicts discrimination accuracy. In addition, subjects may be more biased to accept arguments with belief consistent claims as sound when the topic is more important compared to less important.

Experiment 1

Methods

Subjects. Forty subjects from a large Midwestern U.S. university participated for course credit. Subjects were invited to participate based on responses to their spanking and television violence beliefs in the prescreening described below. Subjects were either believers or disbelievers in both topics (classification procedures described below); 254 subjects were eligible out of a total of 632 who completed the prescreening.

Materials. Prior knowledge tests for spanking and television violence consisted of 20 four-option multiple-choice questions for each topic. The questions addressed terminology and basic research findings for each topic.[2]

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[2]We collected measures of subjects' prior knowledge of the research related to spanking and television violence to assess whether performance on the argument evaluation task may be related to levels of prior knowledge. In Experiments 1 and 2 prior knowledge did not predict d' or C for any group on either topic. In Experiment 3 there was a significant correlation between level of prior knowledge and d' for arguments with belief inconsistent claims. No other variables were related to prior knowledge in Experiment 3. Because of the overall lack of relationship between prior knowledge and any measure of interest in these experiments, we do not discuss prior knowledge further.

The argument evaluation task sentences consisted of a claim followed by a reason, as illustrated in sentences (1.1) to (1.4). A total of 60 sentences were created. Forty were target sentences (20 spanking and 20 television violence sentences). Within each topic the claim position was balanced such that there were 10 pro and 10 con arguments. Claim position was crossed with whether the reason was sound or unsound, resulting in five sentences of each type for each topic. Target sentences averaged 22.4 words per sentence with a Flesch/Kincaid readability score of 11.8. There were no significant differences in sentence length or readability score as a function of any variables. Twenty filler sentences contained the same argument structure but were about different topics and modeled after the arguments used in Britt et al. (2008). They were written to contain different claims suggesting either the implementation of a particular policy (e.g., companies should not be permitted to use sweatshops) or a moral statement (e.g., pornography is harmful for our society). We also measured belief basis, as described by Griffin (2008), which measures the extent to which individuals believe in a topic based on evidence and/or affect. Belief basis was collected in all experiments but did not predict any variables of interest and is not discussed further.

Design and procedure. Potential subjects completed an online prescreening within the first 2 weeks of the semester in which all responses were on a nine-point scale. For beliefs, subjects reported their belief in each proposition (1 = "completely disbelieve," 5 = "unsure whether I believe this," and 9 = "completely believe"). For spanking, the proposition was *spanking is an effective way to discipline a child*. Spanking was defined as "striking a child's buttocks when he or she misbehaves." For television violence, the proposition was *watching television violence causes people to commit real violence*. Subjects who responded 1 to 3 were considered disbelievers, and subjects who responded 7 to 9 were considered believers. In the prescreening subjects also rated their knowledge of the scientific research on each topic ("Not at all knowledgeable" to "Very knowledgeable"). Finally, subjects responded to questions about how important each issue is to them personally and how much they cared about each issue ("Not at all" to "Very much").

Subjects who were believers or disbelievers for both topics were invited via e-mail to participate. Subjects were run in groups of up to 15. All tasks were completed with paper and pencil and responses recorded on scantron sheets. After providing informed consent, subjects first completed the prior knowledge tests. Half the subjects completed the television violence test first and half completed the spanking test first. Next, subjects completed the argument evaluation task. Each subject was randomly assigned to one of four different random orders of the 60 test arguments. Instructions stated that for each argument, subjects should "decide if the reason given supports the claim made. If the reason does support the claim, the item is **acceptable.** If the reason does not support the claim, the item is **flawed**" (emphasis in instructions). After completion of the argument evaluation task, subjects were debriefed and dismissed.

Results

We addressed three primary questions in the data: (1) Does belief consistency with an argument predict differential accuracy at discriminating sound from unsound arguments? (2) Does belief consistency predict overall response biases in favor of accepting belief consistent arguments? (3) Do differences in importance in the topics predict discrimination or bias? To assess any potential differences in general reasoning ability across belief groups, we analyzed discrimination performance on the filler sentences as a function of belief condition for spanking and television violence. There were no significant differences in subjects' ability to discriminate acceptable from flawed filler sentences for either topic in any of the three experiments.

Discrimination and bias. For both d' and C, evidence of belief consistency effects would arise from an interaction between the belief status of the subject and the claim position. Figure 2 presents data for d'. Overall levels of d' were consistently positive, indicating that subjects performed above chance at the task. For each topic ANOVAs were calculated in which claim position was a within-subjects factor and
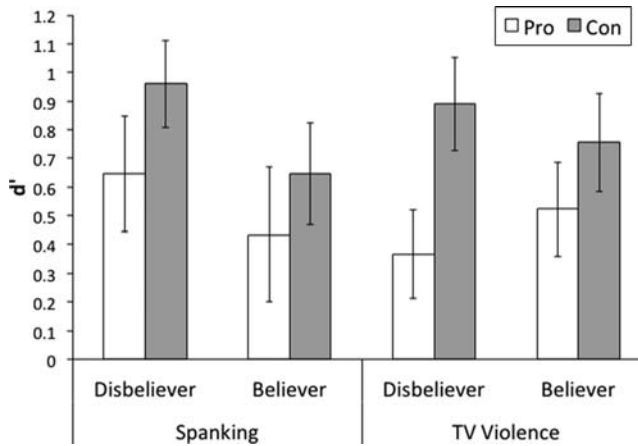
Figure 2. *d'* scores for Experiment 1 as a function of belief status of subjects and claim position for spanking and television violence topics. Disbelievers evaluating con arguments and believers evaluating pro arguments are belief consistent, whereas the opposite are belief inconsistent. Error bars are SEMs.

belief status was a between-subjects factor. For spanking there were no main effects of claim position or belief status and no interaction, $F(1, 38) = 1.00$, ns. For television violence *d'* scores were significantly higher for con sentences ($M = .82$) than for pro sentences ($M = .45$), $F(1, 38) = 7.20$, $p = .01$, $\eta_p^2 = .16$. There was no main effect of belief status and no interaction, $F(1, 38) = 1,11$, ns. Thus, there is no evidence that subjects were more or less accurate at discrimination as a function of belief consistency.

Figure 3 presents data for *C*. For spanking there was no main effect of claim position or belief status, but there was a significant interaction, $F(1, 38) = 5.54$, $p = .02$, $\eta_p^2 = .13$. For television violence there were also no significant main effects of claim position or belief status, but there was a significant interaction, $F(1, 38) = 7.77$, $p = .008$, $\eta_p^2 = .17$. As seen in Figure 3 for both topics, the nature of the interactions are that *C* scores were higher for belief inconsistent argument claims than belief consistent argument claims (con arguments for believers and pro arguments for disbelievers). This result suggests that the decision criterion point is placed more toward "accepting" for belief consistent arguments than belief inconsistent arguments.
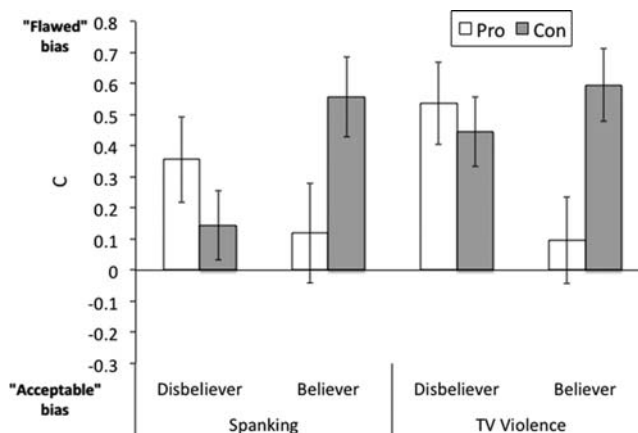

Figure 3. *C* scores for Experiment 1 as a function of belief status of subjects and claim position for spanking and television violence topics. Disbelievers evaluating con arguments and believers evaluating pro arguments are belief consistent, whereas the opposite are belief inconsistent. Error bars are SEMs.

Having better argument discrimination ability may protect against belief bias. To assess this we examined whether the relationship between beliefs and response bias was moderated by discrimination ability. In these analyses we asked whether subjects who have higher levels of discrimination accuracy show less belief-consistent response bias than those with lower levels of discrimination accuracy. Moderation was assessed in regression analyses in which belief status, d', and their interaction were regressed on C for each claim position (pro and con for each topic). The interaction coefficient in the regression represents a test of whether the relationship between belief status and C changes for different levels of d'. For spanking the interactions were not significant ($B = .09$, $t(1, 39) = .76$ for spanking pro sentences, and $B = -.004$, $t(1, 39) = -.04$ for spanking con sentences). For television violence the interactions were also not significant ($B = .11$, $t(1, 39) = .76$ for television violence pro sentences and $B = -.11$, $t(1, 39) = -1.14$ for television violence con sentences). Thus, the response bias differences as a function of beliefs do not vary significantly across levels of discrimination accuracy.

Importance. We were also interested in correlations between discrimination performance, response bias, and ratings of topic importance. For these analyses we combined belief status and claim position data to create measures of belief consistent and inconsistent d' and belief consistent and inconsistent C. For example, pro sentences are belief consistent and con sentences belief inconsistent for subjects who are believers. Means for topic importance were 4.43 for spanking ($SD = 2.06$) and 4.35 for television violence ($SD = 2.16$). Topic importance did not predict d' scores for belief consistent or belief inconsistent measures for either topic. However, topic importance for spanking predicted response bias for arguments with belief inconsistent claims, $r(40) = .33$, $p = .04$. This correlation indicates that subjects who report that the topic of spanking is more important tend to reject arguments with belief inconsistent claims at a higher rates. This correlation was not significant for the television violence topic, however, $r(40) = .17$, ns. Thus, topic importance results are mixed with respect to whether subjects are more likely to be biased in responding as a function of how important the topic is to the subject.

Discussion

Experiment 1 established two basic findings related to our primary questions. First, belief consistency did not predict differential accuracy in evaluating arguments. Subjects were no more or less accurate at discriminating sound from unsound arguments based on whether they believed the claim of the argument. However, because discrimination was greater than zero, we have evidence that participants were reading the entire argument and were generally above chance in evaluation. Second, subjects did show a response bias as a function of belief consistency. For both spanking and television violence topics, subjects were biased toward accepting belief consistent arguments as sound and rejecting belief inconsistent arguments as unsound.

Experiment 2

All participants in Experiment 1 held strong beliefs about a topic. Although we failed to find any differences in argument discriminability for belief consistent versus inconsistent arguments, we did not rule out the possibility that beliefs interfere with argument processing. Consistent with the Voss et al. (1993) model of argument comprehension, the subjects in Experiment 1 may have experienced automatic activation of beliefs and reasons related to their beliefs. These activated beliefs may have, in turn, influenced subjects' ability to discriminate sound from unsound arguments. In Experiment 2, in addition to believers and disbelievers, we included a group of individuals with neutral beliefs. These neutral subjects should not have automatic activation of strong beliefs about the topic. As a result they may be able to reason more clearly about the arguments. Thus, we tested the hypothesis that holding a strong belief about a topic, in either direction, hinders subjects' ability to reason about arguments. If holding a strong belief reduces the ability to reason about that topic, then the neutral group should have better discrimination performance than either belief group.

Including subjects across the full range of our belief scale also affords the opportunity to analyze beliefs as a continuous variable. The hypothesis that beliefs on either end of the continuum hinder discrimination suggests a possible quadratic relationship between beliefs and d' in which d' is highest for the middle range of beliefs. Data for C can also be analyzed with beliefs as a continuous variable. In these analyses we hypothesize linear relationships between C and beliefs for both pro and con sentences. The interaction found in Experiment 1 suggests that the slope describing the relationship between beliefs and C for pro sentences should be negative, whereas the slope describing the relationship between beliefs and C for con sentences should be positive. Thus, we predict an interaction in which the belief $\times C$ slopes are different as a function of claim position.

Methods

Subjects. One hundred eighteen subjects from a large Midwestern U.S. university participated. Subjects were invited to participate based on completion of the same prescreening survey questions described in Experiment 1. Subjects were believers or disbelievers, as described in Experiment 1, or were neutral, as defined by a rating of 4 to 6 on the belief prescreening scale. Thus, all subjects who completed the prescreening were eligible ($n = 571$). For spanking there were 36 disbelievers, 39 believers, and 43 neutral subjects. For television violence there were 40 disbelievers, 28 believers, and 50 neutral subjects.

Materials and procedure. The materials and procedure were identical to Experiment 1.

Results

Discrimination and bias. Data for both d' and C were analyzed with beliefs on a continuous scale. For ease of comparison with the other experiments, Figures 4 and 5 are presented in the same format. Data for d' are presented in Figure 4. Belief consistency effects were analyzed with correlations between beliefs and d' for each topic and claim position. For pro sentences there was no significant correlation between beliefs and d' for spanking ($r(118) = -.09$, ns) or for television violence ($r(118) = -.10$, ns). For con sentences there also were no significant correlations between beliefs and d' for spanking ($r(118) = -.12$, ns) or television violence ($r(118) = -.04$, ns). Thus, we find no evidence that belief consistency is linearly related to argument discrimination. To examine the hypothesis that neutral subjects would obtain higher d' scores, we computed the mean d' score for each subject across pro and con sentences within each topic. We directly examined the hypothesis that neutral subjects would have higher d' scores with regression analyses in which d' scores were regressed on beliefs and beliefs squared. In these regression analyses, the quadratic term tests the nonlinear relationship between beliefs
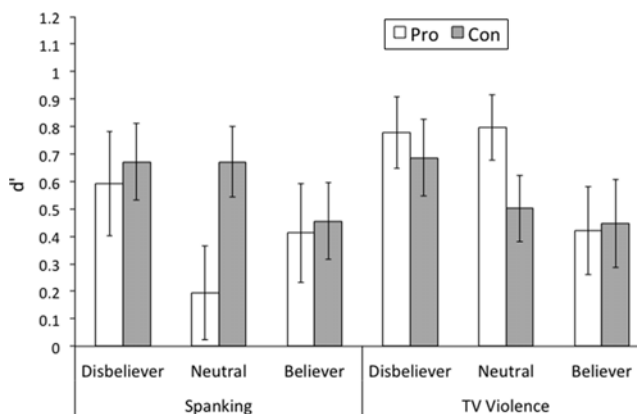

Figure 4. d' scores for Experiment 2 as a function of belief status of subjects and claim position for spanking and television violence topics. Disbelievers evaluating con arguments and believers evaluating pro arguments are belief consistent, whereas the opposite are belief inconsistent. Error bars are SEMs.

Figure 5. *C* scores for Experiment 2 as a function of belief status of subjects and claim position for television violence arguments. Disbelievers evaluating con arguments and believers evaluating pro arguments are belief consistent, whereas the opposite are belief inconsistent. Error bars are SEMs.
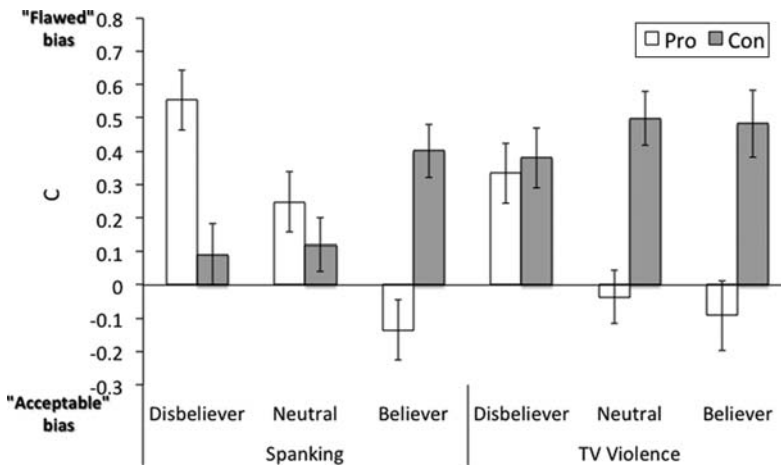
and d'. For both topics the quadratic component was not significantly different from 0 ($B = -.01$, $t(1, 117) = -.36$, for spanking and $B = -.03$ $t(1, 117) = -1.60$ for television violence). Thus, we find no evidence that neutral subjects are better or worse at discriminating argument soundness.

To analyze response bias we regressed *C* scores for pro and con sentences on beliefs. Data for spanking and television violence are presented in Figure 5. For spanking there was a significant negative correlation between beliefs and *C* scores for pro sentences ($r(118) = -.42$, $p < .001$) and a significant positive correlation between beliefs and *C* scores for con sentences ($r(118) = .24$, $p < .001$). To test the interaction between beliefs and *C* scores, we computed a difference score for each subject that was the *C* score for pro sentences minus the *C* score for con sentences. The correlation between this difference score and beliefs was significantly negative ($r(118) = -.45$, $p < .001$). This negative correlation indicates that the simple slopes between beliefs and the two *C* scores are different from each other, replicating the interaction effect shown in Experiment 1. For television violence there was a significant negative correlation between beliefs and *C* scores for pro sentences ($r(118) = -.30$, $p = .001$). The correlation between beliefs and *C* scores for con sentences was not significantly different from 0 ($r(118) = .14$, ns.). The correlation between television violence beliefs and the difference between *C* pro and *C* con scores was significantly negative ($r(118) = -.32$, $p < .001$). Thus, for both topics we replicate the results from Experiment 1 that subjects tend to accept arguments as sound when they are more belief consistent and reject arguments as unsound when they are more belief inconsistent.

As with Experiment 1 we were also interested in the possibility that the relationship between beliefs and *C* is moderated by d'. In regression analyses we regressed *C* scores for each claim position on beliefs, d', and their interaction. For spanking pro sentences the interaction between beliefs and d' was significant ($B = .064$, $t(1, 114) = 3.09$, $p = .003$). The positive beta weight indicates that for higher levels of d', the relationship between beliefs and *C* pro sentences becomes less negative. Thus, subjects who are better at discriminating sound from unsound sentences show less belief-driven response bias. For spanking con sentences the interaction was not significant. For television violence the interaction between beliefs and d' was not significant for either claim position. Thus, for three of the four claim positions we do not find evidence that subjects who are better at discrimination are less biased.

Importance. As with Experiment 1, correlations were calculated between d' and *C* values for belief consistent and belief inconsistent arguments and topic importance. Note that neutral subjects do not have belief consistent or inconsistent scores so were not included. Means for importance were 3.8 for

spanking ($SD = 3.32$) and 3.46 for television violence ($SD = 2.03$). Topic importance did not correlate with any d' or C measure.

Discussion

In summary, we found no evidence in Experiment 2 that performance at discriminating sound from unsound arguments is better for subjects whose beliefs are neutral with respect to the topic. In terms of response bias the results were similar to Experiment 1; subjects were generally biased to accept arguments as sound when they were belief consistent and to reject arguments as unsound when they were belief inconsistent. When analyzed as continuous variables we found that as subjects became more believing of a proposition, they were more likely to accept pro arguments as sound and reject con arguments as unsound, regardless of the argument's actual soundness. Overall, these data provide further evidence that beliefs influence response bias tendencies and not discrimination.

Experiment 3

In Experiments 1 and 2 we found no evidence that the ability to discriminate a sound from an unsound argument varies as a function of belief in the argument claim but that subjects are more likely to accept arguments they believe in compared with ones they do not believe in. In Experiment 3 we examined the possibility that general reasoning ability moderates the extent to which people accept arguments with belief consistent claims. It is conceivable that good reasoners show little or no bias in accepting belief consistent arguments, whereas poor reasoners are more apt to accept belief consistent arguments. By definition, better reasoners should be more adept at evaluating informal arguments. Larson et al. (2004) measured reasoning ability with a subset of questions from the Law School Admissions Test (LSAT), which is used to assess reasoning ability for use as a factor in law school admission decisions. They found that good reasoners were more successful than poor reasoners at correctly identifying claims and reasons in arguments. Poor reasoners also produced errors of argument evaluation; they identified nonreasons as reasons more frequently than good reasoners. Stanovich and West (1997) collected ratings of beliefs for 23 different topics. Then, they had both subjects and experts rate the quality of arguments pertaining to those topics. By regressing subjects' ratings of argument quality on the experts' ratings and subject beliefs, they obtained measures of the unique variance in perceived argument quality that is accounted for by actual argument quality and beliefs. Stanovich and West (1997) found that both expert ratings of argument quality and beliefs accounted for unique variance in subjects' perceived argument quality. In addition, subjects who were better at the rating task (higher expert rating beta weights) had a lower relationship between beliefs and argument quality. This result suggests that subjects who were better at determining the quality of the arguments were less influenced by their beliefs.

We expect that discrimination performance between sound and unsound arguments will be greater for subjects who score higher on a standardized reasoning test (the LSAT) compared with subjects who score lower. At issue is whether reasoning ability protects against the response biases reported in the previous two experiments. If it does, then we should find that lesser reasoning skill is associated with a stronger belief consistent response bias, as measured by C.

Methods

Subjects.   One hundred seventy-three subjects from a large Midwestern U.S. university participated for course credit. Subjects were selected and contacted using the same procedure as Experiment 1. Of 1,212 subjects who completed the prescreening, 410 were eligible. Five subjects were eliminated for failing to finish the experiment in under 1 hour. For spanking, 93 subjects were disbelievers and 80 were believers. For television violence, 86 were disbelievers and 87 were believers.

Materials and procedure.   The materials and procedure were identical to Experiment 1 with the addition of the reasoning ability test. Reasoning ability was assessed with a version of the LSAT,

administered after the sentence reasoning task. The test was adopted from Larson et al. (2004) and consists of 18 multiple choice questions that assess general verbal reasoning ability. Participants were given 20 minutes to complete as much of the test as they could.

Results

We were interested in replicating the results from Experiments 1 and 2 and examining correlations of general reasoning ability with d' and C. In addition to the filler arguments, we analyzed the LSAT reasoning scores to ensure no overall differences in reasoning ability across belief categories. Reasoning scores did not differ as a function of belief category for either topic (F's < 1.5). The mean of the LSAT reasoning scores was 7.65 ($SD = 2.96$), with a skewness of .16. The quartile scores were 5 (25th percentile), 7 (50th percentile), 10 (75th percentile), and 15 (100th percentile). Thus, we have a reasonable distribution of subjects across reasoning abilities and little sign of skewness in the LSAT reasoning scores.

Discrimination and bias. To replicate Experiments 1 and 2, data for d' and C were again analyzed using ANOVAs in which belief status was a between-subjects factor and claim position was a within-subjects factor. d' data are shown in Figure 6. For spanking there were no significant d' main effects and no interaction, $F(1, 166) = .66$, ns. For television violence there also were no d' main effects and no interaction, $F(1, 166) = .03$, ns. Data for C are presented in Figure 7. For spanking there was a main effect in which C values were greater for con sentences ($M = .27$) than pro sentences ($M = .13$), $F(1, 166) = 4.63$, $p = .03$, $\eta_p^2 = .03$. There was no main effect of belief status, but there was a significant interaction, $F(1, 166) = 35.64$, $p < .001$, $\eta_p^2 = .18$. For television violence C scores were significantly greater for con sentences ($M = .36$) than pro sentences ($M = .04$), $F(1, 166) = 26.43$, $p < .001$, $\eta_p^2 = .14$. There was no main effect of belief status, but there was a significant interaction, $F(1, 166) = 23.28$, $p = .001$, $\eta_p^2 = .12$. Consistent with Experiments 1 and 2 the interactions show that subjects were biased toward responding "flawed" when they did not believe the argument claim and "acceptable" when they did believe the argument claim.

We conducted regression analyses to directly test the hypothesis that the relationship between response bias and beliefs is different for students with different levels of reasoning ability. C scores for
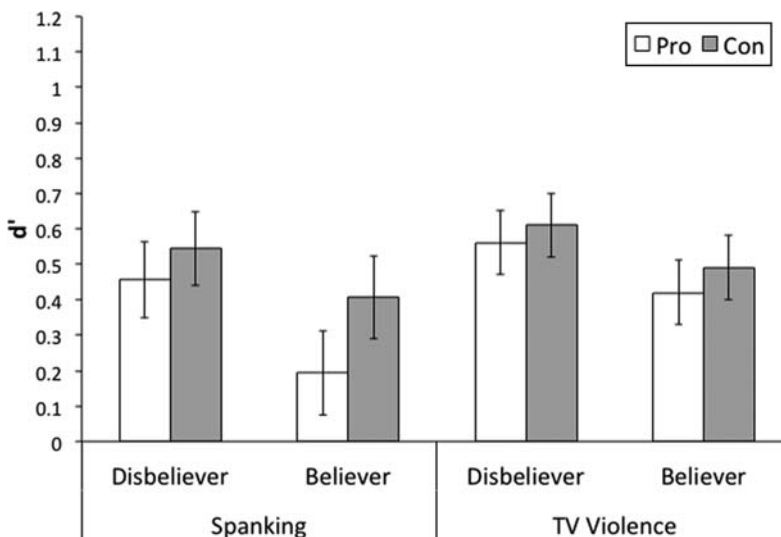

Figure 6. d' scores for Experiment 3 as a function of belief status of subjects and claim position for spanking and television violence topics. Disbelievers evaluating con arguments and believers evaluating pro arguments are belief consistent, whereas the opposite are belief inconsistent. Error bars are SEMs.

Figure 7. *C* scores for Experiment 3 as a function of belief status of subjects and claim position for spanking and television violence topics. Disbelievers evaluating con arguments and believers evaluating pro arguments are belief consistent, whereas the opposite are belief inconsistent. Error bars are SEMs.
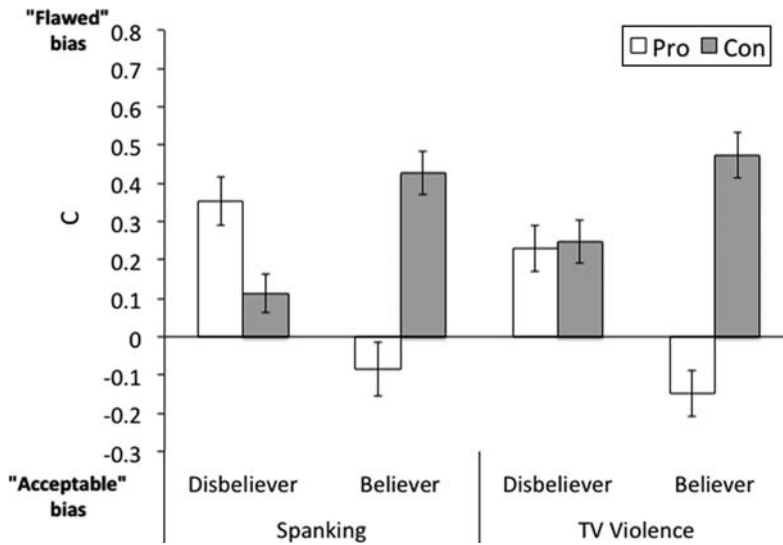
each type of sentence were regressed on belief status (believer or disbeliever), LSAT reasoning ability, and their interaction. If reasoning ability moderates the relationship between beliefs and response bias, then the slope of reasoning ability predicting *C* will be different for the two levels of beliefs, which will be represented as in interaction between belief status and reasoning ability. For spanking pro sentences the interaction between beliefs and reasoning was marginally significant ($B = .03$, $t(1, 163) = 1.94$, $p = .055$). For spanking con sentences there was no significant interaction ($B = -.001$, ns). For television violence the interactions from these regressions were also not significant (for television violence pro, $B = .02$; for television violence con, $B = .01$). Thus, we have no evidence that the difference in bias as a function of belief status differs for good reasoners compared with poor reasoners.

Consistent with Experiments 1 and 2, we again regressed *C* scores on belief status, d', and their interaction to assess whether differences in *C* as a function of belief status vary for different levels of d'. For spanking pro sentences there was a significant interaction ($B = .14$, $t(1, 164) = 3.16$, $p = .002$). The positive beta weight indicates that the subjects who are high in d' show less of a belief-driven response bias than subjects who are low in d'. For spanking con and both television violence sentences the interaction between belief status and d' was not significant.

Reasoning and importance.   Reasoning ability was also examined by calculating belief consistent and belief inconsistent d' and *C* scores in the same manner as Experiment 1. Correlations among relevant variables are presented in Table 1. In terms of reasoning, both belief consistent d' and belief inconsistent d' were positively correlated with the LSAT reasoning score. Across both topics subjects who scored higher on overall reasoning ability were better able to discriminate sound from unsound arguments. *C* scores were uncorrelated with reasoning regardless of belief consistency or topic, so again no evidence suggests that better reasoners are less prone to response bias. Means for topic importance were 4.12 for spanking ($SD = 2.39$) and 3.60 for television violence ($SD = 2.20$). Topic importance for television violence was correlated with *C* scores for arguments with belief inconsistent claims. Unlike in In Experiment 1, this correlation was not significant for spanking. Thus, we find some evidence that subjects who report topics being more important are also more likely to reject arguments that are belief inconsistent. However, this conclusion is not consistent across experiments and topics.

Table 1. Experiment 3 correlations.

	Belief Consistent d'	Belief Inconsistent d'	Belief Consistent C	Belief Inconsistent C	Topic Importance
			Spanking		
Reasoning	.26**	.29***	.14	−.04	−.12
Belief consistent d'	—	.53***	.05	−.11	.06
Belief inconsistent d'		—	.08	−.20*	.02
Belief consistent C			—	−.09	.04
Belief inconsistent C				—	.08
			Television violence		
Reasoning	.25**	.21**	.08	.01	−.14
Belief consistent d'	—	.32***	.03	.03	−.04
Belief inconsistent d'		—	.23**	−.23**	−.14
Belief consistent C			—	−.16*	−.06
Belief inconsistent C				—	.20**

*$p < .05$, **$p < 0.1$, ***$p < .001$.

Discussion

The results of Experiment 3 again replicate the basic findings that subjects are more likely to accept arguments as sound if they believe the claim compared with arguments in which they do not believe the claim. We also replicated the failure to find that subjects are more accurate at discriminating arguments based on whether they believe the claim or not. Finally, although subjects who were better reasoners were more accurate overall, they were equally prone to the response bias phenomenon as subjects who were worse reasoners.

General discussion

We examined students' evaluation of informal arguments as a function of whether the student believed or did not believe the claim made in the argument. Two main findings were replicated across three experiments. First, students consistently showed a response bias in which they were relatively more likely to accept arguments as sound if they believed the argument claim and to reject arguments as unsound if they did not believe the claim. This bias occurs independent of the actual soundness of the argument. This conclusion was revealed by response biases as measured with the C statistic from SDT (Stanislaw & Todorov, 1999). In all three experiments there were interactions between the belief status of the subject and the claim of the argument (pro vs. con). Second, students' belief in the argument claim did not predict their ability to accurately discriminate sound from unsound arguments. d' values calculated from SDT (Swets, 1986) did not differ significantly as a function of belief consistency with the argument claims in any experiment. In Experiment 2 we also found no evidence that holding a strong belief about a topic increases or reduces argument evaluation performance compared with holding a neutral belief. In Experiment 3 we found that students with higher verbal reasoning skill did not show any reduction in response bias compared with students with lower reasoning skill. Furthermore, in all three experiments we found that students with higher argument evaluation performance, as measured by d', did not consistently differ in their level of response bias. Therefore, it did not tend to be the case that students with better discrimination ability were less biased. Finally, prior knowledge of the topics and topic importance did not consistently predict discrimination or bias, and reasoning ability on the filler arguments did not differ across belief groups. We first propose a theoretical interpretation of our results by suggesting that beliefs in argument claims influence the degree of scrutiny that students use when evaluating informal arguments. We also discuss educational implications of these results.

Theoretical Interpretation: Varying levels of scrutiny

When a student comprehends informal arguments such as the ones we examined, we assume that the components of the argument fit into a student's argument schema (Wolfe, 2012; Wolfe et al., 2009). In particular, students understand that the argument contains a claim and a reason and that their task is

to judge the relevance of the reason to the claim. We also assume that relevant knowledge, attitudes, and beliefs about the claim and reason are automatically activated and added to the mental representation of the argument (Voss et al., 1993). As beliefs vary across students, the knowledge representations of the arguments will also vary. We propose that as the consistency changes between beliefs and argument claims, the level of scrutiny that students use to evaluate the arguments also change. When a student believes the claim, relatively less scrutiny is applied to the task of determining whether the reason supports the claim. When the student does not believe the claim, relatively more scrutiny is applied to the task. Students are therefore less likely to find any reason to be relevant to a belief inconsistent claim, regardless of what the reason is. In SDT terms, we suggest that the relevance of a reason to a claim varies on a continuum and that the different levels of scrutiny are implemented as shifts in the decision criterion. The decision criterion is set such that a lower level of relevance is needed to produce an "acceptable" response for belief consistent argument claims and a higher level is needed for belief inconsistent claims. We note again that these differences are relative and not necessarily comparable with a fixed standard of "biased" versus "unbiased."

The claim that students vary in their motivation to reach certain conclusions is generally consistent with research on motivated reasoning (Kunda, 1990). It is also consistent with results from experiments in which students evaluate arguments or information that is belief consistent or inconsistent. Students generate more thoughts when responding to attitude inconsistent arguments (Klaczynski & Robinson, 2000). Wolfe et al. (2009) found that argument agreement was higher for belief consistent arguments. Baron (1995) also found argument quality ratings to be higher for belief consistent arguments. One of the contributions of the current research is that we find similar results with judgments of soundness rather than argument quality or agreement. The soundness judgment is important because it is an educational goal for students to be able to discern sound from unsound arguments (Wolfe, 2011), not just to perceive that they are strong arguments. These results are also generally consistent with the conclusion that readers are motivated to maintain current beliefs and will engage in processing and reasoning in an effort to conclude that their current beliefs are reasonable or correct. In terms of processing effort, our data do not shed light on whether students put more effort into evaluating belief inconsistent claims, which some authors have suggested (Edwards & Smith, 1996; Klaczynski & Robinson, 2000). If subjects do engage in analytic (vs. heuristic) processing for arguments with belief inconsistent claims, it does not result in improved discrimination ability. Nevertheless, we did not measure processing in the current research, so we leave it for future research to further examine any potential processing differences as a function of belief consistency.

In Experiment 3 we found that better overall reasoning ability predicted better overall argument discrimination ability but did not relate to reasoning biases. These results lead to the conclusion that even good reasoners appear to shift their decision criterion when judging informal arguments with belief consistent and belief inconsistent claims. Proper argument evaluation requires the generation of a quality representation of argument meaning. However, Britt et al. (2008) have demonstrated that most readers of arguments generate an imprecise gist-like representation of argument claims. Our data suggest that believing in a claim does not change the quality of the representation. As such, one should not expect an increased or decreased ability to discriminate sound from unsound arguments. Our current results are also consistent with less systematic attempts to examine the relationship between belief in an argument and judgments of soundness (Britt et al., 2008; Wolfe et al., 2009). For example, Britt et al. (2008) found that agreement with argument claims did not predict memory for the arguments. If agreement did influence the quality of the argument representation, it could be expected that memory for arguments would relate to agreement with the claims.

One limitation of the current research that affects the generalizability of the findings is that the arguments were one sentence in length and only addressed two topics. The number of topics was restricted by our need to assess beliefs in a separate prescreening task and have subjects respond to a large number of arguments about the same topic. It remains for future research to determine whether these belief and reasoning findings replicate in more extended arguments and for different topics. A second limitation is that subjects could not be randomly assigned to conditions based on

beliefs and that the pro and con arguments were necessarily different in content. These limitations were somewhat addressed, however, in that our primary results were interactions in which belief and argument type conditions were crossed with each other as within subjects variables. Thus, all subjects responded to both belief consistent and inconsistent arguments. One issue that remains for future research is to determine if subjects who are better at general reasoning, such as graduate students, may not show belief biases that we find in the current experiments. But given that our participants were college students, our reasoning scores likely reflect an educated population. Finally, future research should address the mental representations of informal arguments more directly. Judgments of argument soundness do not represent direct tests of the mental representation of the information.

Educational implications

Our results suggest that when engaging in the important process of evaluating informal arguments, students suffer from two types of difficulties that stem from their previous beliefs. First, students' beliefs bias their evaluation of the soundness of arguments. Students are relatively more likely to reject arguments when they disbelieve the claim and accept them when they believe the claim. This bias could lead students to be less willing or able to update beliefs based on an erroneous assumption that the arguments supporting their beliefs are more sound than arguments opposing their beliefs. Students enter educational settings with a range of misconceptions about topics they will study (Kendeou, Walsh, Smith, & O'Brien, 2014; Kowalski & Taylor, 2009; Taylor & Kowalski, 2004). Kendeou et al. (2014) present a model of knowledge revision in which correct and incorrect knowledge needs to be activated simultaneously in working memory for knowledge revision to begin to take place. Knowledge revision processes are not discussed in terms of the potential for students to reject arguments based on an erroneous belief that the arguments are unsound, however. Further research should explore the role of beliefs in terms of students' willingness to consider arguments with belief inconsistent claims without rejecting them on the grounds that they are unsound.

The second difficulty students may suffer from is that despite a bias toward accepting arguments with belief consistent claims, students do not appear to be any more successful at actually discriminating sound from unsound arguments when they believe them. We did not directly test the hypothesis that students put more effort into evaluating arguments with belief inconsistent claims. Our results, however, suggest that even if they do, this effort results in no better ability to determine the actual soundness of the arguments. Therefore, it is left for future research to determine what factors may actually help students to improve their ability to evaluate these types of arguments.

Another potential issue is that when students read documents about controversial topics they are at times presented unsound belief-consistent arguments. Holding a belief may increase the likelihood that students will incorporate that unsound argument into their knowledge of that topic. Both inside and outside of formal instruction, it is common for students to read arguments that contain incorrect conclusions. Unfortunately, it may also be the case that this incorrect information becomes part of the students' knowledge base. For example, students have been shown to incorporate the incorrect answer options on multiple choice tests into their knowledge of a topic (Roediger & Marsh, 2005). A similar effect may be true for argumentation. If so, then reading unsound arguments with belief consistent claims may increase students' misconceptions. According to the results found in this research, increased student misperceptions could then lead to an increase in biased reasoning about new arguments in the future.

Acknowledgments

References

Baron, J. (1995). Myside bias in thinking about abortion. *Thinking and Reasoning*, *1*, 221–235.

Britt, M. A., Kurby, C. A., Dandotkar, S., & Wolfe, C. R. (2008). I agreed with what? Memory for simple argument claims. *Discourse Processes*, *45*, 52–84.

Britt, M. A., & Larson, A. A. (2003). Constructing representations of arguments. *Journal of Memory and Language*, *48*, 794–810.

Ditto, P. H., Scepansky, J. A., Munro, G. D., Apanovitch, A. M., & Lockhart, L. K. (1998). Motivated sensitivity to preference-inconsistent information. *Journal of Personality and Social Psychology*, *75*, 53–69.

Dube, C., Rotello, C. M., & Heit, E. (2010). Assessing the belief bias effect with ROCs: It's a response bias effect. *Psychological Review*, *117*, 831–863.

Edwards, K., & Smith, E. E. (1996). A disconfirmation bias in the evaluation of arguments. *Journal of Personality and Social Psychology*, *71*, 5–24.

Evans, J. S. B., Barston, J. L., & Pollard, P. (1983). On the conflict between logic and belief in syllogistic reasoning. *Memory & Cognition*, *11*, 295–306.

Griffin, T. D. (2008). Faith: Serving emotional epistemic goals rather than evidence coherence. In V. Sloutsky, B. Love, & K. McRae (Eds.), *Proceedings of the 30th Annual Conference of the Cognitive Science Society*, 2059–2064, Austin, TX: Cognitive Science Society, Inc.

Holbrook, A. L., Berent, M. K., Krosnick, J. A., Visser, P. S., & Boninger, D. S. (2005). Attitude importance and the accumulation of attitude-relevant knowledge in memory. *Journal of Personality and Social Psychology*, *88*, 749–769.

Howard-Pitney, B., Borgida, E., & Omoto, A. M. (1986). Personal involvement: An examination of processing differences. *Social Cognition*, *4*, 39–57.

Kendeou, P., Walsh, E. K., Smith, E. R., & O'Brien, E. J. (2014). Knowledge revision processes in refutation texts. *Discourse Processes*, *51*, 374–397.

Klaczynski, P. A., & Robinson, B. (2000). Personal theories, intellectual ability, and epistemological beliefs: Adult age differences in everyday reasoning biases. *Psychology and Aging*, *15*, 400–416.

Kowalski, P., & Taylor, A. K. (2009). The effect of refuting misconceptions in the introductory psychology class. *Teaching of Psychology*, *36*, 153–159.

Kuhn, D. (2010). Teaching and learning science as argument. *Science Education*, *94*, 810–824.

Kunda, Z. (1990). The case for motivated reasoning. *Psychological Bulletin*, *108*, 480–498.

Larson, A. A., Britt, M. A., & Kurby, C. A. (2009). Improving students' evaluation of informal arguments. *Journal of Experimental Education*, *77*, 339–365.

Larson, M., Britt, M. A., & Larson, A. A. (2004). Disfluencies in comprehending argumentative texts. *Reading Psychology*, *25*, 205–224.

National Center for Education Statistics. (2010). *The nation's report card: Grade 12 reading and mathematics 2009 national and pilot state results* (NCES 2011–455). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, Washington, DC.

Oakhill, J., Johnson-Laird, P. N., & Garnham, A. (1989). Believability and syllogistic reasoning. *Cognition*, *31*, 117–140.

Roediger, III, H. L., & Marsh, E. J. (2005). The positive and negative consequences of multiple-choice testing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *31*, 1155–1159.

Schank, R. C., & Abelson, R. P. (1977). *Scripts, plans, goals and understanding: An inquiry into human knowledge structures*. Oxford, UK: Lawrence Erlbaum.

Stanislaw, H., & Todorov, N. (1999). Calculation of signal detection theory measures. *Behavioral Research Methods, Instruments, & Computers*, *31*, 137–149.

Stanovich, K. E., & West, R. F. (1997). Reasoning independently of prior belief and individual differences in actively open-minded thinking. *Educational Psychology*, *89*, 342–357.

Swets, J. A. (1986). Indices of discrimination or diagnostic accuracy: Their ROC's and implied models. *Psychological Bulletin*, *68*, 301–340.

Taylor, A. K., & Kowalski, P. (2004). Naïve psychological science: The prevalence, strength, and sources of misconceptions. *Psychological Record*, *54*, 15–25.

Thompson, V., & Evans, J. S. B. T. (2012). Belief bias in informal reasoning. *Thinking & Reasoning*, *18*, 278–310.

Toulmin, S. E. (1958). *The uses of argument*. Cambridge, UK: Cambridge University Press.

Voss, J. F., Blais, J., Means, M. L., Greene, T. R., & Ahwesh, E. (1989). Informal reasoning and subject matter knowledge in the solving of economics problems by naive and novice individuals. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 217–249). Hillsdale, NJ: Lawrence Erlbaum Associates.

Voss, J. F., Fincher-Kiefer, R., Wiley, J., & Silfies, L. N. (1993). On the processing of arguments. *Argumentation*, *7*, 165–181.

Voss, J. F., & Means, M. L. (1991). Learning To reason via instruction in argumentation. *Learning and Instruction*, *1*, 337–350.

Voss, J. F., & Van Dyke, J. A. (2001). Narrative structure, information certainty, emotional content, and gender as factors in a pseudo jury decision-making task. *Discourse Processes*, *32*, 215–243.

Wolfe, C. R. (2011). Argumentation across the curriculum. *Written Communication*, *28*, 193–219.

Wolfe, C. R. (2012). Individual differences in the "myside bias" in reasoning and written argumentation. *Written Communication*, *29*, 477–501.

Wolfe, C. R., & Britt, M. A. (2008). The locus of the myside bias in written argumentation. *Thinking & Reasoning*, *14*, 1–27.

Wolfe, C. R., Britt, M. A., & Butler, J. A. (2009). Argumentation schema and the myside bias in written argumentation. *Written Communication*, *26*, 183–209.

Wolfe, M. B., Tanner, S. M., & Taylor, A. R. (2013). Processing and representation of arguments in one-sided texts about disputed topics. *Discourse Processes*, *50*, 457–497.