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Belief Change and Memory for Previous Beliefs after Comprehension of Contentious Scientific Information

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Abstract

We explored the relationship between belief change and recollection of previous beliefs. Subjects reported beliefs about TV violence. Later, subjects read a one-sided, belief inconsistent text. We manipulated whether subjects reported beliefs after reading first, or recollected previous beliefs first. A third group was told their previous beliefs before reporting current beliefs. Recollections were not improved when subjects recollected beliefs first. When told previous beliefs, belief change was reduced, suggesting a desire to appear consistent.

Keywords: text comprehension, beliefs

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There is no argument that people forget things over time. The longer the time-span, the

more likely we are to forget. When we look at our own past, we reconstruct it through hindsight

in light of our experiences that have taken place since the original memory. In the words of Ross

& Conway (1986), "we forget, and we fill in the gaps in memory by inferring what probably

happened" (p.123). This phenomenon holds true for people's attitudes and beliefs. Attitudes can

change gradually over time. Research has shown they may also change abruptly, in the face of

convincing arguments (Bem & McConnell, 1970; Goethals & Reckman, 1973; McFarland &

Ross, 1987; Levine, 1997; Ross, 1985). Additionally, this research has shown that when people

change their attitudes, they incorrectly report their previous beliefs or attitudes as being similar

to their newly formed attitudes (Bem & McConnell, 1970; Goethals & Reckman, 1973;

McFarland & Ross, 1987; Levine, 1997; Levine, Lench, & Safer, 2009; Ross, 1985; Wolfe,

2013). This bias in recall has been demonstrated for attitudes such as frequency of tooth brushing

(Ross, McFarland, Fletcher, 1981), attitudes toward exercise (Ross, 1985), and bussing to

achieve racial integration (Goethals & Reckman, 1973). Subjects in these studies reported their

attitudes, then later experimenters manipulated their attitudes by instructing them to write

counter-attitudinal essays or take part in a discussion with a confederate, who was given strong

arguments against subjects' original attitude and did most of the talking, before then reporting

their new attitudes and being asked to recall their original ones. Individuals in all of these

experiments consistently showed a change in attitude following the manipulation.

Wolfe (2013) demonstrated the same effect among students studying scientific

information about a contentious topic. Students who believed spanking was effective versus

ineffective read scientific texts that were inconsistent with their beliefs. Students changed beliefs following reading, and then overestimated the similarity between their original beliefs and their new ones.

The relationship between current beliefs and recollection of previous beliefs is not well understood. Perhaps the most influential factor involved when we attempt to remember previously held beliefs is our present mental state. Not only is it most salient but also because we often assume such beliefs to be relatively stable over time unless there is an obvious reason that they should not be (Ross & Conway, 1986).

Ross & Conway (1986) reason that when individuals attempt to reconstruct personal histories, they adopt implicit theories of either stability or change. What motivates us to adopt either theory is unclear and varies across contexts. In general, people are inclined to view themselves as consistent in their beliefs, abilities and personality (Ross & Conway, 1986). There is debate over the mechanism involved in this assumption of consistency. Cognitive dissonance creates a feeling of discomfort or embarrassment when an individual posses two or more contradictory beliefs (Festinger, 1957). Goethals & Reckman (1973) argue that knowledge of one's own inconsistency of attitudes may induce cognitive dissonance. Individuals subsequently distort their recollection of past attitudes as to appear consistent with current beliefs in order to reduce this dissonance. This explanation requires individuals to assume consistency of attitudes however, as noted by Ross & Conway (1986), it also requires belief change to be salient to subjects for them alter their recollections. Biased memory for previous attitudes has also been interpreted as a product of impression management (Bem & McConnell, 1970). Similar to dissonance theory, impression management motivates individuals to appear consistent over time. Where this differs from the former is that the motivation stems from the impressions of others on

the individual rather than the subjects' impression of themselves. However, neither is always the case in all attitude-manipulation experiments. In many of the experiments, including our own, the true purpose is disguised, and therefore subjects have no reason to believe they are being judged on the consistency of their attitudes, but rather the accuracy of their memory. We would assume subjects to be motivated toward performing well on tasks that they perceive are related to the purpose of the study. Therefore subjects may not experience dissonance just because their beliefs changed during the course of the study. Yet subjects in previous studies who change their attitudes are often unaware that they have changed and still assume cognitive temporal consistency (Ross & Conway, 1986).

The present study attempts to shed light on these possible explanations. In this study, all subjects read a scientific text that is inconsistent with a prior belief the subject holds. We attempt to replicate Wolfe (2013) with a new topic, TV violence causing real aggression, and address two factors that may be involved in this relationship. First, stating a current belief may interfere with people's ability to recollect previous beliefs. In previous research, current beliefs are stated before recollections. Stating a belief and then recalling how one felt earlier may be motivating subjects to recall past beliefs as similar to the current ones. If recollections are generated without interference from current beliefs, they may be more accurate. We address this possibility by manipulating the order that subjects state current vs. recollected beliefs. The first condition is similar to the typical recollection paradigm used by previous research where subjects' beliefs are first manipulated, and then they give a rating of their current belief before recalling what they originally reported several weeks earlier. We add an additional condition where the order of reporting current belief and then recalling the original is reversed. Subjects in the second condition rate their beliefs in the topic of TV violence along with other filler topics, to serve as a

manipulation check, then are invited back later and presented with a text that is inconsistent with their belief on TV violence. We then ask them to first recall their original beliefs before asking them to rate their present beliefs. By comparing belief change and subsequent memory bias between these two conditions we will be able to examine first, whether we succeed in replicating the belief change phenomenon for TV violence and second, whether the act of explicitly stating a belief affects recollection more because the present attitude is more salient. If we find a difference between these two conditions, it would suggest that individuals are aware of belief change but alter recollections to appear consistent.

Second, the relationship between current and previous beliefs may be driven by a desire to appear consistent across time (Ross & Conway, 1986; Ross, 1989). People may experience dissonance after changing beliefs (Festinger, 1957). This dissonance may be resolved by altering the reporting of current or recollected beliefs so they appear similar. We address this possibility with a third condition where subjects are reminded of their previous belief before reporting their current belief. Rather than asking subjects to recall their earlier belief, we tell subjects what they reported and then ask them to rate their current belief. Since we are reminding subjects of their past beliefs, we cannot measure any bias in memory for these beliefs. We can, however, examine whether a desire for consistency will affect a belief change manipulation. If subjects desire to appear consistent, current beliefs after a reminder would be more similar to previous beliefs than when there is no reminder. For a more detailed representation of the present design, see figure 1. Our manipulations at time 2, for all conditions, of the order of post-belief report and recollections for the first two conditions as well as the reminder of pre-beliefs for the third condition are all presented in Figure 1.

An additional goal is to address potential consequences of belief recollection errors. We examine the hypothesis that subjects who more accurately recollect that their beliefs have changed will be more interested in reading texts about this topic. The basic logic of this prediction is that if a subject has a large error in recollecting his or her previous beliefs, they may erroneously believe that their beliefs have not changed. In that circumstance, subjects may believe that reading new information on the same controversial topic will be unlikely to change their beliefs. In contrast, a subject who more accurately recollects that his or her belief has indeed changed may more likely be aware that their beliefs do change when they read new information. Under that circumstance, subjects may be more willing or interested in reading further information about the topic. We address this question with a task in which subjects rate their interest in reading a number of new articles, some of which are one-sided articles relating to our topic of television violence.

Method

Subjects

One hundred sixty six subjects from a large Midwestern United States University participated. Subjects were selected based on their reported beliefs concerning television violence from a prescreening test at the beginning of the semester. One hundred sixty participated in exchange for partial credit in an Introductory Psychology course, and six received a ten-dollar gift card. Data from 16 subjects were discarded due to failure to follow directions or computer error.

Materials

Two texts were created that present one-sided arguments regarding the scientific literature related to the potential link between television violence and aggression. In the "TV Yes" text,

evidence is presented that suggests viewing television violence causes people to commit real violence. One section discusses how children are naturally predisposed to imitate adult behavior whether that behavior is appropriate or not. Two other sections discuss aggression in towns before and after television were introduced and longitudinal research. The text is 1,815 words with 19 paragraphs and has a Flesch-Kincaid grade level score of 11.7. The "TV No" text suggests that there is not enough evidence to make a causal conclusion about the link between television and actual violence. Some of the same research topics in the TV Yes text are discussed. Problems with the research and inconsistent findings are used to make a case that the causal link is inconclusive. The TV No text is 1,898 words with 19 paragraphs and has a Flesch-Kincaid grade level score of 10.6.

The prior knowledge test consists of 20 4-option multiple-choice questions. The questions address terminology and basic research findings in media and violence research. The sentence recognition test utilized 60 sentences, with 30 taken from each text. For each text, every sentence was rated by a separate group of subjects on two dimensions: the extent to which the sentence supports the proposition and the extent to which the sentence refutes the proposition. Support and refute ratings were used in a different capacity for an earlier study by Wolfe et. al. (2013) and are on a continuous scale. In the present study, the ten sentences with the highest support ratings from each text were used as support sentences. The mean rating for the ten support sentences from the 'TV Yes' text was 7.64 and 7.23 for the ten from the 'TV No' text. The ten sentences with the highest refute ratings were used as the refute sentences. The mean rating for the ten refute sentences within the TV Yes text was 5.18 and 6.38 for the ten from the TV No text. Ten sentences that were neutral on both ratings were used as neutral sentences. The specific sentences that serve as target and distractors depend on which text is read. For each

subject, the sentences from the text read are targets (old), and the sentences from the other text are distractors (new). Each sentence can be characterized in terms of the extent to which it both supports and refutes the text position.

The PANAS-X (Watson & Clark, 1994) is a sixty-item measure of emotional states. The PANAS-X measures positive affect and negative affect as general emotional states. The Need for Cognition (NFC) scale (Cacioppo, & Petty, 1982) is a measure of "the tendency for an individual to engage in and enjoy thinking" (Cacioppo & Petty, 1982). The NFC has eighteen items that the individual rates using a 9-point Likert-style scale.

Belief change was measured by comparing the belief ratings of each subject, pre and post manipulation on the topic of TV violence and other filler topics, which we did not manipulate. Filler topics included homosexuality as a choice, spanking as disciplinary tool, and social media's effect on relationships. Filler topics served as a manipulation check to ensure the texts used produced significant belief change. Ratings were measured using a 1 (strongly disagree) to 9 (strongly agree), Likert-style scale. The difference between pre beliefs and post beliefs gave us a measure of belief change. For example if, in the prescreening, a subject responded to the statement "viewing television violence causes people to commit real violence" with 9 (strongly agree) but after manipulation reported 4 (moderately disagree) they have a belief change score of 5. Recollection bias was measured by comparing recollection ratings to the original pre beliefs. For instance, if a subject rated their belief in the topic as 9 but their recollection were 5, we subtracted the original belief rating from the recollection to get a recollection bias rating of 4.

Memory for the text content was assessed with a sentence recognition task. Recognition was measured using signal detection theory (Swets, 1964). d' is a measure of subjects' ability to discriminate sentences that were read from sentences that were not read. The logic of the test is

that subjects with better comprehension of the text will have a better ability to discriminate sentences they read from sentences they did not read. d' was calculated separately for support, refute, and neutral sentences. Ten old and ten new sentences were used for each sentence type. Thus, there were a total of twenty support sentences; twenty refute sentences, and twenty neutral sentences. Position consistent sentences were supporting sentences within the 'TV Yes' text and refuting sentences in the 'TV No' text. Position inconsistent sentences were refuting sentences within the 'TV Yes' text and supporting sentences within the 'TV No' text.

For the article-rating task, subjects rated their interest in reading each of twenty articles based on their titles using a Likert-style scale (1=not interested at all, 9=very interested). Of the twenty titles, three clearly support the proposition that viewing TV violence causes real violence (*Watching Violence Makes for Angry Kids, Study Shows*; *TV Bloodbath: How Violent TV Makes Violent Teens*; *Media Violence: Why We Like it and Why it's Making Us so Violent*) and three titles clearly refute the position: (*Television and Violence: What We Watch Does Not Make Us Who We Are*; *Yes TV is Violent. But Does it Make us Violent? No*; and *Research Shows Violent Media do not Cause Violent Behavior*). The remaining article titles address topics that are unrelated to Television violence and aggression.

Procedure

Subjects' reported beliefs about TV violence effects as part of a prescreening survey within the first two weeks of the semester. The on-line survey was self-paced, and contained unrelated questions pertaining to other experiments. Subjects reported their belief in the proposition that viewing television violence causes people to commit real violence on a nine-point scale (1 = "completely disbelieve", 5 = "unsure whether I believe this", and 9 = "completely believe"). Subjects who responded 1-3 on the belief scale were classified as

disbelievers and subjects who responded 7-9 were classified as believers. Believers and disbelievers were invited by email to sign up for the actual experiment.

The experiment took place anywhere from 2 to 12 weeks after the on-line prescreening. All parts of the experiment were run individually at computer terminals, with up to four other subjects per session. Subjects began by completing the multiple-choice test. Subjects were assigned to read the text that was *inconsistent with their belief* on TV violence from the prescreening. Both texts were read one sentence at a time in a moving window fashion. The text appeared one paragraph at a time with all letters converted to dashes (-), except for the current sentence. Punctuation was maintained. Section titles appeared with the first paragraph of each section and were treated as separate sentences. Subjects were instructed to read each sentence until they understood it, and then press the spacebar. At that point, the current sentence turned back into dashes and the next sentence turned from dashes to text. After the last sentence of a paragraph, the first sentence of the next paragraph appeared as text with the rest of the paragraph as dashes. Following the text, subjects completed the PANAS-X and Need for Cognition scale to serve as a delay.

Following the questionnaires, subjects were reminded of the responses they gave to statements in the prescreening. Subjects were told that the purpose of the reminder was to verify that their data had been correctly matched. An experimenter sat individually with the subject and read responses the subject reported on the prescreening. Subjects verified that the responses were ones they had reported. Subjects in both the current belief first and recollection first conditions verified seven responses including the filler topics that were unrelated to TV violence. Subjects in the previous belief given condition verified their responses to the same seven items and also verified their TV violence belief rating.

After completing the verification task, subjects reported current and recollected beliefs for TV violence and filler topics according to their condition. In the "current belief first" condition, subjects reported their beliefs and then recollected their previous belief from the prescreening. In the "recollection first" condition, this order was reversed. In the "previous belief given" condition, subjects only reported their current beliefs after being reminded of their responses in the verification task.

Subjects next completed the sentence recognition task. Sixty sentences were presented one at a time, randomized for each subject. Instructions stated that subjects should decide if each sentence was presented word-for-word in the text they read. If so, they pressed a button labeled "old", and if not, they pressed the "new" button. The task was self-paced. Next, subjects completed the article-rating task at their own pace. Titles appeared one at a time on the computer; subjects rated their interest in reading each article on a nine-point scale. Finally, subjects were debriefed and dismissed.

Results

We examined the extent to which reading a one-sided scientific text, which is inconsistent with an individual's previously reported belief, affects subjects' reporting of their current belief and the magnitude of recollection error when asked to recall the originally reported belief. Other questions we address are whether order effects of recollection and reported beliefs at time two or reminding subjects of their earlier beliefs impact these findings. We also investigated subjects' interest in seeking new information as a consequence of belief change and recollection bias. Analysis of sentence reading times, Need for Cognition, and Positive/Negative Affect did not predict any belief change or recollection bias so we will not discuss them any further.

Belief Change and Belief Memory Bias

Belief ratings for half of the scores were flipped (i.e. scores of 1 were changed to 9, 2 was changed to 8, 3 to 7, and 4 to 6). It was not a goal of our study to distinguish believers from disbelievers and we did not anticipate there to be any significant differences between the two. Our concern was to assess the magnitude of belief change in both groups. By flipping half of the ratings, we were able to have a single, positive measure of belief change. Mean belief change and recollection bias scores for TV violence and filler topics within each condition are shown in Table 1. Belief change for the experimental topic of TV violence was significantly greater than for the filler topics. The mean belief change score for TV Violence was 2.73 among both groups compared to the filler topics that all had a mean belief change score of around 1 (see Table 1). The "post first" condition replicates Wolfe (2013). Subjects that reported beliefs then recollected previous beliefs had a mean belief change of 2.51 (Table 2). These recollections were more similar to current than previous beliefs. Mean recollection bias score within this condition was 1.47. When the belief recollections were reported first, post beliefs and recollections were not significantly different than in the Post first condition. Mean belief change for recollection first was 2.73 and the mean recollection bias was 1.98 (Table 2). In both conditions, recollections were significantly different from pre beliefs, and similar to post beliefs. Multiple regressions assessed the variance in pre recollections that is accounted for by pre and post beliefs. In both conditions, post beliefs are a better predictor of pre recollections than the actual pre beliefs. In the post first condition, post beliefs accounted for significant variance in recollections over and above pre beliefs, partial r = .60, F (1, 40) = 23.15, p<. 0001. Pre beliefs did not significantly predict recollections, however, partial r = -.11, ns. In the recollection first condition, post beliefs

again accounted for significant variance in recollections, partial r = .42, F (1, 40) = 14.98, p<. 0001. Pre beliefs did not significantly predict recollections, partial r = .15, ns.

Reminders of Previous Beliefs

Subjects who were reminded of their previous beliefs showed much smaller shifts from their original beliefs within in both texts. Mean belief change for subjects within this condition was 1.72 (Table 2). Table 1 clearly shows belief change as being significantly less for subjects who are reminded of pre beliefs before reporting new beliefs compared to the first two conditions. In the Pre belief given condition, belief ratings were significantly more similar to pre beliefs than in the two recollection conditions, F (1, 132) = 4.84, p = .03.

Interest in Seeking New Information

For article interest ratings, the mean of the three Yes and three No article titles were calculated. As shown in Table 3 and Figure 3, belief change from pre to post did not predict interest in Yes (r = -.06, ns) or No (r = -.09, ns) article titles. The magnitude of subjects' recollection error, however, negatively correlated with interest in both Yes (r = -.22, p=. 04) and No (r = -.23, p=. 01) article ratings (see Figure 4). Ratings of Yes and No article titles were highly correlated (r=.77, p=.00). As a result we combined both into a single scale and found that the magnitude of recollection error and the mean rating both position consistent and inconsistent article titles were negatively correlated (r=-.26, p=.01). Thus, subjects who were more accurate in reporting that their beliefs had changed were more interested in reading articles that were both consistent and inconsistent with their previous beliefs.

Discussion

We first replicated previous belief recollection bias findings (Goethals & Reckman, 1973; Levine, 1997; Levine & Safer, 2002; Ross, 1989; Wolfe, 2013), primarily the belief recollection error finding of Wolfe (2013) in scientific text comprehension. Subjects changed beliefs in the direction of the text position, and then misrecollected their previous beliefs. An important question we addressed in this study concerned the nature of this recollection bias. Two common explanations are that this is a product of a genuine memory error, meaning that recollections are made using the most currently available mental representation held by the subject (Levine & Safer, 2002; Ross, 1989) or that the bias is socially motivated by a desire to appear consistent (Gawronski & Strack, 2012).

Implicit Theories of Stability

The research of Ross (1989) suggests that individuals tend to assume their attitudes are consistent over time. Current beliefs bias our ability to accurately recollect earlier ones because people tend to view their attitudes and beliefs as things that are relatively stable across time. Even when beliefs change, individuals are not always aware that they have in fact changed, because they typically adopt an implicit theory of stability when reconstructing their past. So, when people base their current attitudes or beliefs on their current mental representation and available information, they tend to already harbor this theory of stability, which creates a bias in recollection. Even those who do not first state their new belief before remembering their earlier one still experience the same distortion of memory. We find supporting evidence that when beliefs change, it is not always salient to the subject. When subjects recollected their previous belief before reporting their post belief, recollection errors and current beliefs did not change compared to when post beliefs were reported first. It is not clear whether other circumstances

exist where recollection accuracy may be improved. Nevertheless, we have no evidence that recollection of previous beliefs can be improved compared to previous studies.

Desire for Consistency

Subjects who were reminded of their original belief reported significantly less of a change in their belief compared to the other two experimental conditions (Figure 2). This finding expands upon the understanding of belief change and recollection by suggesting that social factors affect explicit belief change in a way to appear consistent over time. When subjects were told their previous beliefs, they reported less belief change than when they were not. This result is consistent with a desire to appear consistent across time. However, further research is needed to rule out the possibility that providing previous beliefs merely serves as additional information that subjects have difficulty ignoring when reporting current beliefs. It may be that subjects experienced much less of a change in belief because the reminder of their previous belief was given to them orally from an experimenter. The presence of a presumed authority figure (an experimenter) to a naïve subject may induce are greater need to appear to be consistent as opposed to if subjects were simply reminded of their old beliefs by means of a computer prompt. We may see less of a difference of belief change if the subjects reported a discrepancy between their past and present attitudes anonymously.

Consequences of Belief Memory Bias

The article rating data provide an initial suggestion about the value of understanding when beliefs have changed. The high correlation of interest in both "Yes" and "No" article titles suggest that overall interest in any new information may be a predictor of belief memory bias magnitude. Students who were more accurate in their recollection of previous beliefs showed more of an interest in reading information that was both consistent and inconsistent with their

currently held beliefs (Figure 4). This suggests that those who are aware that their beliefs have

changed may be more open to reading texts with a broader range of positions on contentious

topics. Interest in seeking new information did not predict belief change however, so we cannot

assume that those who are more likely to seek out new information change their beliefs any less

than those who do not. The relationship between article interest and recollection bias does

suggest that those with a desire to learn more about a subject are less likely to so quickly assume

a stability mindset. Further research is needed to determine if perhaps the desire for new

information can predict more or less change in attitudes and beliefs. Furthermore it would be

interesting to investigate how social motivators such as impression management and cognitive

dissonance may affect interest in seeking out new information, both consistent and inconsistent

with how the subject feels at the present time.

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Tables

Table 1

Belief change and recollection bias among TV violence and filler topics.

Topic	Belief change (Std. Dev.)	Recollection bias (Std. Dev.)
TV violence***	2.73 (1.91)	1.97 (1.67)
Homosexuality	.94 (1.18)	.68 (1.05)
Social media	1.01 (1.51)	.90 (1.28)
Spanking	1.03 (1.49)	.77 (1.22)

Note: Belief change and recollection bias measures were significantly higher for the topic of TV violence compared to the filler topics suggesting the manipulation did in fact cause subjects to shift their beliefs towards the text position.

Tables

Table 2

Belief change and recollection bias for TV violence among all three conditions after combining

believers and disbelievers

	Current belief first	Recollection first	Pre-belief given
Belief change	2.51	2.73	1.72
Recollection bias	1.47	1.98	

Note: Belief change for the current first and recollection first conditions did not differ

significantly from each other. However, there is a significant difference of belief change for these

two conditions compared to the pre-belief given condition. For a graphic representation of this

data, see Figure 2.

Tables

Table 3

Belief change and recollection error correlations with article interest for Yes and No titles

	"Yes" Title Ratings	"No" Title Ratings
Believers (No Text)		
Belief Change	-.17	-.02
Recollection Bias	-.39*	-.09
Disbelievers (Yes Text)		
Belief Change	.05	-.18
Recollection Bias	-.16	-.32

Note: (*p<.05) Correlations between belief change and interest in article titles are not present. A significant correlation is present between recollection bias and article interest. Ratings of yes and no article titles were highly correlated (r=.77). As a result ratings were combined into a single scale that measured overall interest in seeking new information and correlated with magnitude of recollection bias (see Figure 4).
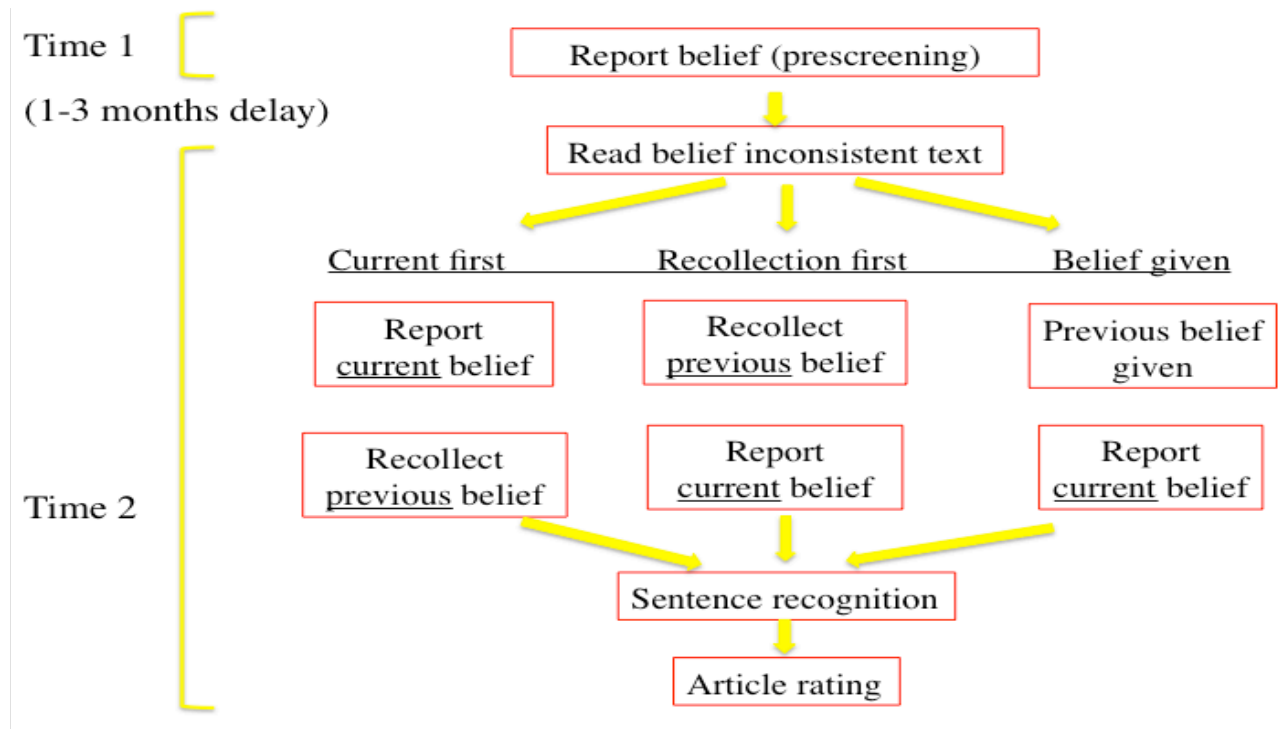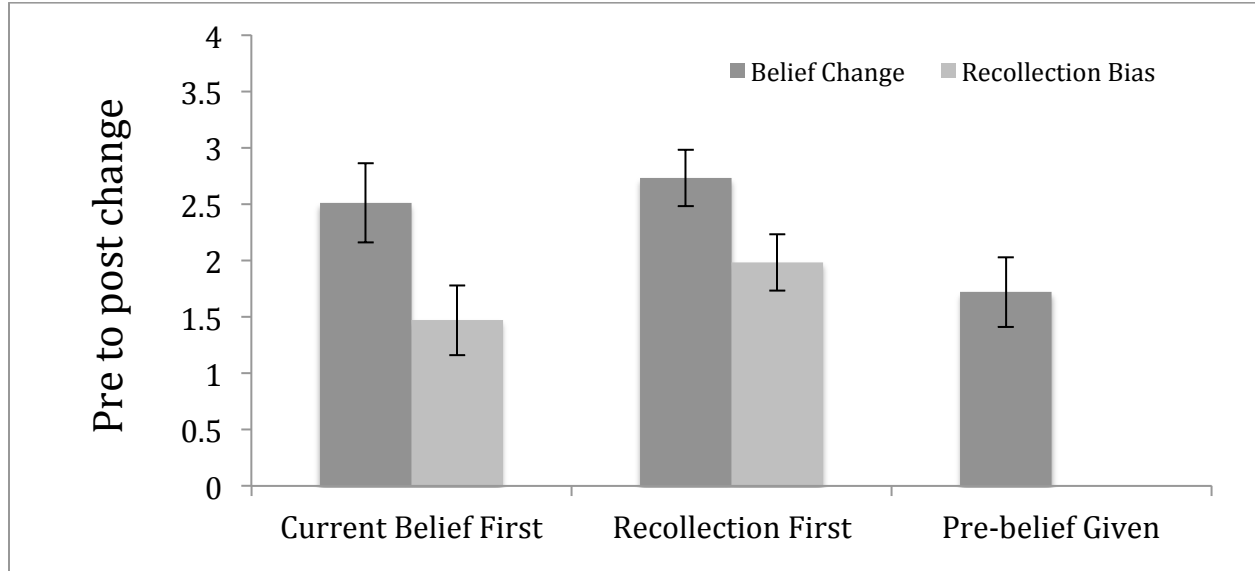
Figures

Figure 1. Visual diagram of all three conditions and their manipulations during time 2 following

the belief inconsistent text. Orders of recollection and reporting new belief are manipulated for

the first two conditions and a reminder of previous beliefs are given to the third condition.

Figures

Figure 2. Belief change and recollection bias scores for each condition. Believers ("Yes" text) and disbelievers ("No" text) have been combined so data is separated by condition rather than by text read. No significant difference of belief change or recollection bias is shown between the first two conditions. However, a significant difference for belief change between the first two conditions and subjects who were reminded of their earlier belief is present.
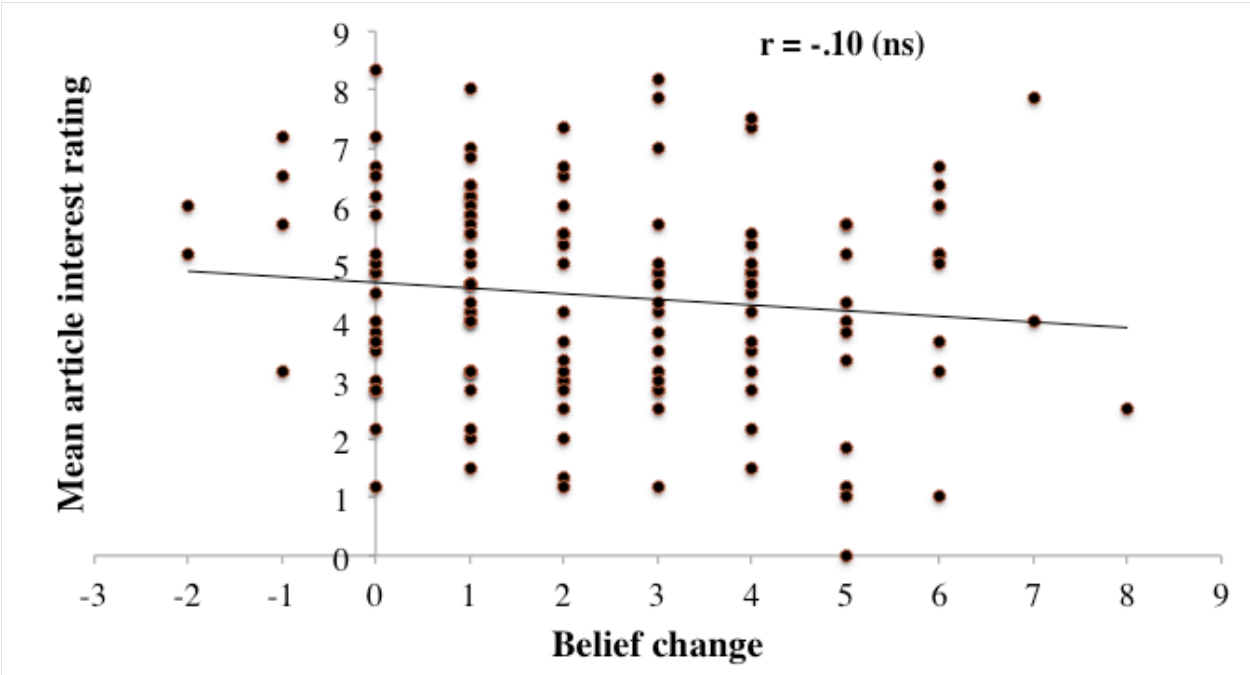
Figures

Figure 3. No significant correlation is present between mean article interest rating and magnitude of belief change.
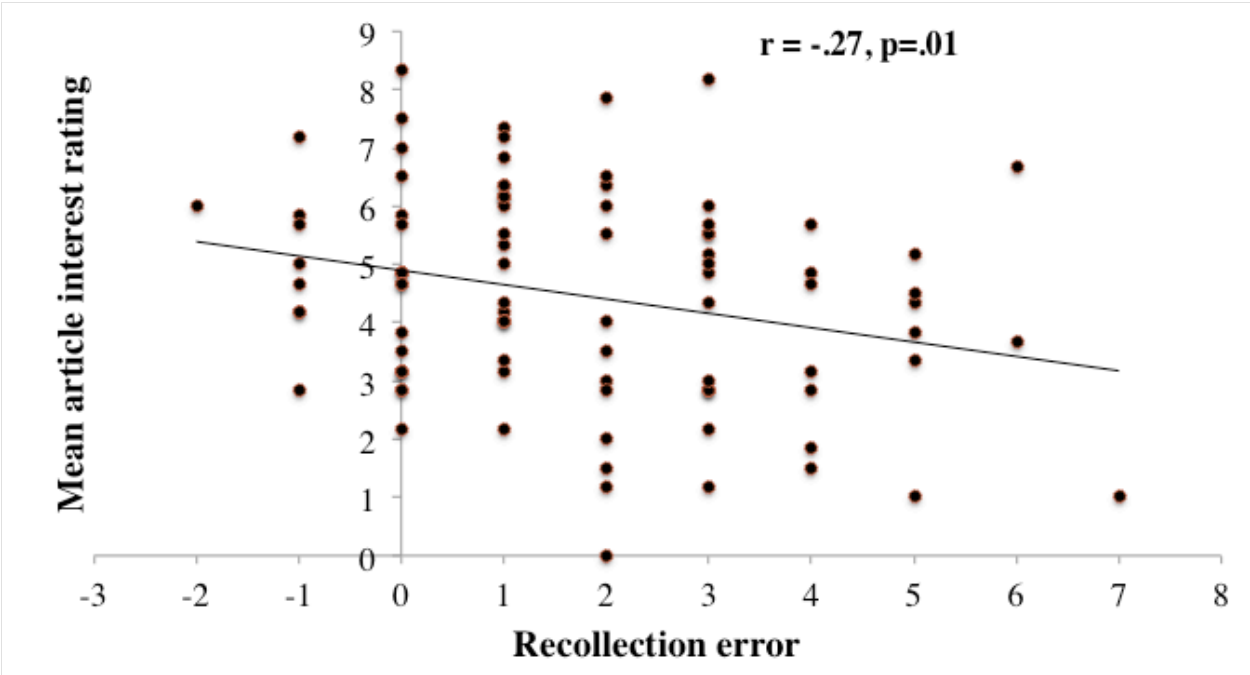
Figures

Figure 4. Magnitude of article interest for both yes and no article titles correlated with magnitude

of recollection error between both post-belief first and pre-belief first conditions (r=-.27, p=.01).