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Manipulating Belief Bias Across the Lifespan

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Abstract

In today's political climate, when basic facts and reasoning are seemingly up for debate, it is increasingly important to be able to identify well-reasoned arguments, regardless of one's political leanings, and to retain this skill throughout the lifespan. Research has shown, however, a persistent belief bias—a tendency to judge an argument's validity based on its conclusion's agreement with one's beliefs, rather than its logical quality. Other findings suggest that belief bias can be reduced by instruction to avoid belief bias. The current project seeks to explore whether older adults, believed to be more prone to biased reasoning, respond differently to such instruction, as well as to identify other potential individual differences in belief bias. Participants (41 young adults, 33 older adults) completed an online survey in which they were asked to evaluate valid and invalid syllogisms about political topics, both before and after instruction to avoid belief bias. Contrary to the literature, there was no significant difference between the bias scale scores or correction post-manipulation based on age group; however, response to de-biasing instructions was inversely related to political conservatism. Findings call into doubt the general statement that older adults are categorically more biased, and further research is suggested.

Manipulating Belief Bias Across the Lifespan

Which of the following categorical syllogisms is deductively valid?

All A are B.
No B are C.
Therefore, no B are C.

All tigers are mammals.
No mammals can breathe air.
Therefore, no tigers can breathe air.

Everyone motivated to work seeks jobs feverishly.
No welfare recipients seek jobs feverishly.
Therefore, no welfare recipients are motivated to work.

Because an argument is deductively valid if, assuming the truth of the premises, the conclusion must also be true, each of the arguments above is a valid argument; their internal logic is consistent. However, people have consistently struggled to solve such problems, especially when arguments concern topics about which they have strong opinions.

Belief Bias

It has perhaps never been more important on a societal level to be able to separate sound, well-reasoned arguments from those that fail to survive scrutiny. As reviewed by Hunt (2014), however, researchers have long noticed effects of believability and familiarity (along with other properties particular to an argument's content) on study participants' reasoning (see, e.g., Wilkins, 1929). Termed "belief bias" (Revlin, Leirer, Yopp, & Yopp, 1980), the phenomenon has become one of the best-studied subjects in judgment and decision-making (see, e.g., Anderson et al., 2019; Evans, Barston, & Pollard, 1983; Evans, Newstead, Allen, & Pollard, 1994; Klauer, Musch, & Naumer, 2000; Newstead, Pollard, Evans, & Allen, 1992). Broadly put, participants are more likely to accept the logical validity of an argument if its conclusion is consistent with prior belief, and to reject the logical validity of an argument if its conclusion

refutes prior belief, regardless of the argument's objective validity (Hunt, 2014).

Theorized Models for Belief Bias

Experiments attempting to quantify and understand the cognitive mechanisms involved in belief bias have produced a complicated and confusing pattern of results that belies attribution to a single theory (Klauer et al., 2000). However, many hypotheses have been advanced, of which three have achieved the most empirical support. While discerning between the models is not the primary objective of this study, it is worthwhile to consider them briefly.

Selective scrutiny and the dual-process model of reasoning. Extensive research suggests that there are (at least) two separate ways in which people process information. While terminology varies, the first type of information processing is generally understood to be implicit, predominantly automatic and based primarily on feelings and intuitions. The other type of processing is explicit, a predominantly conscious activity involving active reasoning and analysis (Myers, 2010). Scholars of reasoning processes have applied this concept to their field. According to Heit, "In these two-process accounts there is one system that is relatively fast but heavily influenced by context and associations, and another system that is more deliberative and analytic or rule based" (2007, p. 9). One hypothesis concerning belief bias suggests that the bias arises when individuals heuristically apply the first implicit style of reasoning when they agree with an argument's conclusion, and only resort to explicit analysis of the argument if they disagree with its conclusion. This model has come to be termed the selective scrutiny model (Klauer et al., 2000).

Numerous studies have advanced support for the selective scrutiny model of belief bias. Evans, Barston, and Pollard (1983) first suggested the model as a potential explanation for their consistent finding over three experiments of an interaction between logical validity and

believability of conclusion in participants' acceptance of deductive syllogisms as valid: there was a much stronger effect for actual logical validity when a given syllogism was invalid as compared to when the syllogism was valid. Participants tended to accept invalid arguments with believable conclusions but were warier when arguments were valid but contained unbelievable conclusions. Moreover, participants who were in a verbal protocol condition in which they were asked to think aloud as they worked out the problem tended to refer explicitly to the syllogisms' premises when employing logic in their analysis but referred to irrelevant information (i.e., information not contained within the premises of the syllogism) when they were more swayed by the believability of the conclusion.

Klaczynski and Robinson (2000) investigated the relationships between individual differences, participant variables, and reasoning biases, including belief bias, in order to ascertain when and what kind of individuals employ implicit versus explicit processing. Their findings generally supported the dual-process model in that participants with a greater disposition towards analytic reasoning showed less evidence of reasoning biases. Interestingly, their results also indicated that "[i]f evidence is theory congruent, processing continues to be predominantly heuristic. Cognitive vigilance, accuracy motivation, and efforts to prevent memory interference are low; the data are assimilated into theory; and arguments for evidence acceptance are often superficial" (p. 412).

Evans and Curtis-Holmes (2005) combined an investigation into belief bias and the dual-process model of reasoning generally. According to their analysis, explicit analytical reasoning is much slower than implicit heuristic reasoning. "The reason for this is that analytic processing is a sequential process requiring use of central working memory and is constrained by its limited capacity. By contrast, heuristic processes operate through massively parallel implicit systems

that exert an unconscious influence on responding" (p. 382). They hypothesized that when participants were required to evaluate arguments quickly—within ten seconds—they would show greatly increased belief bias as they would be required to employ implicit heuristic reasoning nearly exclusively. Their data confirmed their hypothesis; participants in the controlled-timing group based their argument evaluations significantly more on belief and significantly less on logic than participants in the free-timing group. Not only do their results strongly support the dual-process model of reasoning, but they also lend credence to the notion that belief bias is heightened when participants are prevented from fully scrutinizing the internal logic of a problem.

The selective scrutiny model is not without its critics. Selective scrutiny suggests that individuals examine the conclusion of an argument first; only on a finding that it disagrees with their beliefs do they resort to logical analysis of the problem. Because belief bias results when individuals ignore the logical value of the argument in favor of their agreement with the conclusion, it would follow then that the logical complexity of the problem would have no effect on belief bias, because in instances where belief bias controls the outcome, no logical analysis at all has been performed. However, when Stupple and Ball (2008) varied the logical complexity of the syllogisms in an argument evaluation task, they found that there was a greater belief bias effect for more complex syllogisms. It must therefore be the case that even in instances where participants agreed with the arguments' conclusions, at least some logical analysis is performed—a process not allowed for in the selective scrutiny and dual-process models. Moreover, if participants were relying wholly on rapid heuristic reasoning before resorting to explicit logical analysis, then it would be expected that they would spend less time evaluating belief-consistent arguments and more time evaluating belief-dissonant arguments. Research,

however, has found evidence for the opposite: participants tend to spend *more* time evaluating arguments when they agree with its conclusion (Ball, Phillips, Wade, & Quayle, 2006; Thompson, Striemer, Reikoff, Gunter, & Campbell, 2003). (Stupple and Ball (2008) found no significant difference in response latency between syllogisms with believable and unbelievable conclusions, though they did find that participants spent more time evaluating invalid syllogisms than valid ones.)

Misinterpreted necessity. Reasoning biases are traditionally tested with formal syllogisms. Typically, therefore, the response asked of participants is whether the conclusion to a syllogism is *necessarily* true—that is, if the premises are true, the conclusion *must* also be true—because this is the analysis demanded in formal logic (Hunt, 2014; Hurley, 2012; Politzer, 2011). The misinterpreted necessity model of belief bias supposes that participants, unfamiliar with this particular logical demand, do not understand or do not engage with the parameters of the task. Instead of rejecting an argument whose conclusion is not necessarily true given the premises, participants instead determine whether the conclusion *cannot* be true given the premises (Evans et al., 1983; Newstead et al., 1992). Then, as Newstead and colleagues (1992) summarized, participants faced with the type of invalid argument in which the conclusion may be but is not necessarily true, they "are more likely to base their responses on the only other cue they have available, that is, their knowledge of the world" (p. 262).

This type of tiered approach to reasoning has been observed in various contexts outside the laboratory which speak to its external validity. One key real-world domain in which the processes of reasoning are paramount is service as a juror. Much research—and at least one moderately popular network television show (Rotten Tomatoes, 2019)—has been devoted to the topic of the malleability of juries and the manipulation of their biases in determining the outcome

of a court case (for an overview, see Greene & Heilbrun, 2011). While numerous such biases have been consistently identified, time and again studies have found that the most important factor in predicting a jury's verdict is the strength of the evidence with which they are presented (Greene & Heilbrun, 2011; Myers, 2010; Visher, 1987). However, when evidence alone is not convincing, jurors tend to disregard the instruction that they are then to find for the party not bearing the burden of proof, and they instead resort to more-biased reasoning. According to Myers (2010):

> The facts of a case are usually compelling enough that jurors can lay aside their biases and render a fair judgment. When the evidence is ambiguous, however, jurors are more likely to interpret it with their preconceived biases . . . (p. 578)

Direct research into misinterpreted necessity in the context of belief bias has found relatively ambiguous evidence itself. Certainly, the theory shows some merit. Newstead and colleagues (1992), for instance, found that when participants were given determinate syllogisms (that is, syllogisms which show the conclusion to be either necessarily true or necessarily false), no belief bias was detected, whereas indeterminate syllogisms showed definitive belief effects. Crucially for the present investigation, they also found that when participants were specifically instructed to indicate whether or not the conclusion was *necessarily* true, they showed greater accuracy than participants for whom logical necessity was not so stressed. However, this reduction was seen only for believable—not neutral (meaningless)—conclusions. If uncertainty about the criteria for a sound or unsound argument were driving belief bias, then more specific instructions should also have helped participants determine the correct response when beliefs were no help and they were presumably simply guessing. Because this was not seen, misinterpreted necessity appears incomplete as the sole cause of belief bias.

Mental models. The mental models theory of belief bias is based on Johnson-Laird and Bara's (1984) mental models theory of reasoning in general (Klauer et al., 2000). The theory suggests that individuals generate a conceptual model based on the premises of an argument against which they compare the given conclusion. If the conclusion is inconsistent with the model, then it is rejected; if it is not inconsistent with the model, then it is retained as possible. In some instances, alternative models are sought which might disconfirm the conclusion; in other instances, the argument is accepted as valid at this juncture (Johnson-Laird & Bara, 1984; Oakhill, Johnson-Laird, & Garnham, 1989). According to the mental models theory, belief bias arises when the reasoner's first model generates a conclusion consistent with preexisting beliefs which prompts him or her to accept the conclusion without generating additional models (Torrens, Thompson, & Cramer, 1999).

A fair amount of research shows evidence that is consistent with the mental models theory. Newstead, Pollard, Evans, and Allen (1992) tested the mental models theory directly against the selective scrutiny model and the misinterpreted necessity model by using only determinate syllogisms (i.e., those in which the conclusion either must be or cannot be true given the premises) and varying the number of possible mental models that could possibly be generated. For example, the premises "All widgets are blurbs; all blurbs are dongles" prompt only one potential model—that of a widget which is also a blurb and a dongle—whereas the premises "Some widgets are blurbs; no blurbs are dongles" prompt multiple models: that of a widget which is a blurb (and therefore not a dongle) and that of a widget that is not a blurb (and therefore may be a dongle). Newstead and colleagues (1992) found that when only one mental model was possible (which would then by necessity be dispositive for the argument), no interaction of belief and logic was observed, but when multiple models were possible, the

interaction was seen (although, confusingly, in certain instances there was no main effect of belief).

Torrens, Thompson, and Cramer (1999) measured participants' reasoning ability and the extent to which they generated alternative models in reasoning scenarios. Their findings suggested that the more alternative models a participant tended to generate, the less susceptible they were to belief effects and belief bias specifically.

Debiasing in the Context of Belief Bias

The logical next step after the identification of a particular bias is to investigate whether people can be induced to reduce the bias's effect on their reasoning. Indeed, Lilienfeld and colleagues (2009) wrote, "research on combating extreme confirmation bias should be among psychological science's most pressing priorities" (p. 390). In this tradition, several "debiasing" techniques have been tested against belief bias, and the consensus appears to be that debiasing is possible, but only sometimes, and not completely. Evans and colleagues (1994) sought to replicate Newstead and colleagues' (1992) finding that enhanced instruction in the principles of good reasoning could reduce the effect of prior belief on reasoning. In Experiment 1, participants failed to respond to the enhanced instruction, while in Experiments 2 and 3, participants reduced their bias but not enough to eliminate significant belief effects, whether or not the principle of logical necessity was emphasized.

Anderson and colleagues (2019) also tested methods of debiasing, albeit less directly. Rather than placing the burden on participants to eliminate their own bias, they investigated whether the method of information presented (probabilistic, absolute, or graphic-based) could influence participants' bias. Once attention was controlled for, participants recruited through Amazon's Mechanical Turk did indeed show less bias when information was presented in a

graphical format—allowing for easy visual comparison of various nested sets—as compared to the other methods of information presentation.

Aging and Reasoning Biases and Heuristics

Generally, research on aging and reasoning has not been kind to older adults. Klaczynski and Robinson (2000) investigated proneness to reasoning biases among a sample of 172 young adults, 51 middle-aged adults, and 52 older adults involving faculty with the law of large numbers, in the tradition of the representativeness heuristic (Kahneman & Tversky, 1972), and the ability to critically evaluate hypothetical scientific research. On 10 of 12 bias measures, middle-aged and older adults were more prone to "uncritically accept evidence favorable to their positions and to dismiss, often with arguments based on principles of scientific inquiry, evidence that depicted their beliefs as inaccurate and that portrayed the groups they favored negatively" (Klaczynski & Robinson, 2000, p. 411).

Stanley and Blanchard-Fields (2011) studied differences in correspondence bias between young adults and older adults, seeking to replicate findings that older adults tended towards greater exhibitions of correspondence bias (Blanchard-Fields, 1994; Blanchard-Fields & Horhota, 2005). Specifically, they sought to explore beliefs about behavior as potential explanations. Indeed, they found that such beliefs mediated the relationship between age and bias. Importantly, they found that, contrary to the popular theory attributing older adults' bias to diminished cognitive ability (see, e.g., Gonsalkorale, Sherman, & Klauer, 2009), fluid intelligence was not a significant predictor of bias.

Goals of Current Study

The current study was designed to accomplish two main goals: to replicate the belief bias effect generally, and to explore whether older adults' greater bias is potentially attributable to

differences in attitudes and beliefs, especially about reasoning.

Methods

Participants

Forty-one young adults (18 to 30 years old, *n* = 37 female) from the undergraduate population of a large Midwestern university and thirty-three older adults (60 to 80 years old, *n* = 25 female) from the community were recruited to participate. Young adult participants were compensated with course credit; older adult participants were compensated with entry into a drawing for one of two gift cards.

Materials and Procedures

This study used a 2 x 2 (age group, pre-/post-manipulation) mixed (quasi-experimental, pretest-posttest) design. Participants were asked to complete an online survey through Qualtrics survey software which included an introduction which served as informed consent, a demographics section (including whether or not the participant had had training in formal logic), the 12 Item Social and Economic Conservatism Questionnaire (SECS; Everett, 2013), the Shipley Institute of Living Scale vocabulary test, the Actively Open-minded Thinking (AOT) Scale (seen most recently in Stanovich & West, 2007), and an Argument Evaluation Task (AET), described below. Finally, participants were asked to indicate their own estimation about to what degree their beliefs influenced their responses on the first and second sets of arguments, how much more effort they expended to remain objective for the second set of arguments as compared to the first, how many of the political arguments they believe argued against their beliefs, and their estimation of the political orientation of the argument writer. Except for the introduction and demographics questionnaire, the order and placement of the measures before or after the AET was randomized. The survey was not openly available on the Web or indexable by

search engines.

Argument Evaluation Task (AET). The AET consisted of an equal number of valid and invalid[1] categorical syllogisms whose content was related to four topics from the SECS (abortion, limited government, traditional marriage, and welfare benefits), as well as eight categorical syllogisms involving neutral categories (e.g., "widgets" and "blurbs"). Half of the arguments were "for" the given topic, and half were "against" the topic. Participants were asked to indicate on a six-point Likert-type scale the logical validity of the argument (from "Very Weak, Invalid" to "Very Strong, Valid") such that a response was either correct or incorrect. (See *Figure 1*.) Responses were coded from 1 to 6 according to the participants' own expressed beliefs on each topic (or according to soundness in the case of the neutral arguments), such that a higher score indicates greater agreement with prior beliefs, and then averaged to create a bias scale score. A bias scale score of 3.5, then, would indicate no bias; a lower bias scale score would indicate a bias *against* one's beliefs. After each topic appeared four times (two "for" the topic and two "against" it; two valid and two invalid), participants were presented with a screen briefly describing belief bias and explaining that, for the remainder of the arguments, they were to evaluate the arguments independently of their personal beliefs. (See *Figure 2*.) Participants then evaluated 16 new arguments (and four neutral arguments), as before. Finally, participants were asked to estimate to what degree they believed their responses on each set of arguments were influenced by their own preexisting beliefs; how much more effort they expended to be objective in the second set of beliefs, as compared to the first; how many arguments they believed argued against their own beliefs; and to estimate the political orientation of the

[1] To protect objectivity of items, invalid syllogisms were invalid by form, rather than due to an untrue premise. Participants were instructed to assume the truth of the premises.

argument writer.

The procedure for generation of AET items varied depending on whether the intended item was to be valid or invalid. For valid arguments, the syllogistic structure was randomly selected from the exhaustive list of valid syllogism structures (as enumerated by Hurley, 2012). For invalid arguments, a logical structure was randomly generated and checked against the list of valid structures to ensure no valid structure had been inadvertently generated. Then, a conclusion proposition of the type dictated by the chosen structure was written such that it was either for or against the given topic. A relevant middle term was chosen, and the two premises were thus built. Finally, all three propositions were edited to better represent conventional English usage. A sample (logically valid) item can be seen in *Figure 1*. It is important to note that the random generation of invalid structures resulted in a wide range of invalid arguments, some of which were nearly indistinguishable from valid ones, but some of which contained, for instance, conclusions which directly contradicted one of the premises.

Careful readers will notice the incongruity between an argument's binary validity—an argument can be either valid or invalid, with no gray area—and the response requested of the participant—that is, a rating of the argument's validity on a scale of one to six. Ultimately, the question asked of participants became, absurdly, "How many valid is this argument?" The decision not to remain faithful to principles of deductive logic was made to capture the uncertainty in a response that may have given rise to the misinterpreted necessity model of belief bias, discussed above. According to the misinterpreted necessity model, participants who are unable to determine the validity of an argument but are nonetheless asked to give a binary valid/invalid response will resort to their preconceived biases, one of which is the target of this study. It seemed worthwhile to be able to discern between incorrect responses corresponding to

uncomfortable uncertainty as opposed to those corresponding to strong and stubborn conviction. Indeed, one participant later contacted the researcher to lament the omission of a "no clue" option (personal communication). On the assumption that participants unsure about an argument's validity (and not wholly controlled by beliefs) would be more likely to choose a less-extreme option, then, six possible answer choices were used.

The *12 Item Social and Economic Conservatism Scale* (SECS). In order to evaluate participants' responses according to their own subjective beliefs about the given topics, a measure of political beliefs and orientation was necessary. Therefore, participants were asked to complete a modified version of the *12 Item Social and Economic Conservatism Scale* (Everett, 2013). The scale asks participants to rate on a "feeling thermometer" the degree to which they feel positively or negatively about twelve topics related to contemporary American political conservatism. The SECS has shown good construct validity, with relationships to self-reports of political party and ideology, as well as to constructs also related to conservatism such as right-wing authoritarianism, dogmatism, prejudice, and social dominance (Everett, 2013).

Typically, the SECS allows participants to respond in multiples of 10 on a scale from 0 to 100, with a response of 50 indicating neutrality about an issue. Because AET items were to be coded according to beliefs measured solely by SECS item responses, it was necessary to disallow participants from responding neutrally. Therefore, instead of a maximum of 100, participants were allowed a scale of 0 to 90, with responses of 50 or greater interpreted as being "for" a given issue, and responses less than or equal to 40 interpreted as being "against" the issue.

The *Actively Open-Minded Thinking Scale* (AOT) and *Cognitive Reflection Test* (CRT). To examine whether attitudes towards reasoning could account for age differences in bias, as beliefs about behavior accounted for correspondence bias in research by Stanley and

Blanchard-Fields (2011), participants were asked to complete the *Actively Open-Minded Thinking Scale* (see Stanovich & West, 2007). The AOT is a forty-one-item scale that asks participants to indicate on a six-point Likert-type scale their agreement with statements involving, for example, the importance of revising beliefs in light of new evidence or whether religious authorities should decide moral issues.[2]

Because the AOT is a measure of attitudes rather than behavior, the *Cognitive Reflection Test* (Frederick, 2005) was also included as a measure of participants' actual tendency towards methodical, explicit reasoning. The CRT is a three-item measure which asks participants to solve language-based arithmetic problems which have a strongly intuitive, but incorrect, answer. For instance, the first item reads, "A bat and a ball cost $1.10 in total. The bat costs $1 more than the ball. How much does the ball cost?" The correct answer is five cents, but participants who fail to work the problem explicitly are expected to answer that the ball costs ten cents.

The *Shipley Institute of Living Scale* vocabulary test. The vocabulary portion of the revised *Shipley Institute of Living Scale* (Shipley, 1940; Zachary, 1986) was also administered to participants in an effort to rule out differences in verbal ability as an explanation for different performance on the argument evaluation task. The scale is commonly used in research settings and consists of forty words of increasing complexity and rarity whose synonyms participants are asked to select from a list of four possible options, and was seen here as appropriate for estimating participants' faculty with language.

Results

Contrary to the literature and to the predicted results, older adults showed no more belief bias than young adults before the manipulation, $t(55.997) = 0.104$, $p > .05$, or after the

[2] Per Stanovich (personal communication), items from the AOT may not be reproduced here.

manipulation, $t(72) = 0.411$, $p > .05$, and showed no significant difference in adjustment to bias scale score after the manipulation, $t(72) = 0.337$, $p > .05$. (Descriptive statistics are reproduced in Table 1.) Participants were more accurate for invalid syllogisms than for valid ones, paired-samples $t(74) = 2.883$, $p < .01$; however, against expectations, there was no overall belief effect at all prior to the manipulation, one-sample $t(73) = 0.181$, $p > .05$, or after the manipulation, one-sample $t(73) = 0.621$, $p > .05$, and there was no significant effect of the manipulation itself, paired samples $t(73) = 0.526$, $p > .05$, despite the fact that participants performed significantly better than chance both pre-manipulation, one-sample $t(73) = 8.221$, $p < .001$, and post-manipulation, one-sample $t(73) = 10.626$, $p < .001$.

Significant results only appeared, as it turned out, unintentionally. To preserve validity of the SECS, the entire twelve-item scale was used, rather than merely the four topics of interest for the argument evaluation task. Because OAs had significantly higher SECS scores than YAs, $t(72) = 2.30$, $p < .05$, attempts were made to tease out age differences by controlling for conservatism in a repeated-measures ANCOVA. The analysis revealed, quite unexpectedly, a significant (linear) interaction between SECS score and the effect of the manipulation. In fact, an attempted stepwise multiple regression analysis did find a significant regression equation, $F(1, 72) = 5.59$, $p < .05$, $R^2 = .072$, but only SECS, ß = -.268, was entered into the analysis; age group and scores on the AOT and CRT were not significant predictors (see Figure 3 for scatterplot).

One age effect did emerge, albeit also unexpectedly, and not in the context of belief bias specifically. A significant inverse relationship was found between SECS score and the perceived political orientation of the argument writer for the AET items; the more conservative the participant, the more liberal they judged the person writing the arguments, and vice-versa, $r = -338$, $p < .01$. However, when the age groups were examined separately, the correlation only

remained significant (and was stronger) for older adults, $r = -.551$, $p < .001$. For young adults, there was no significant correlation, $r = -.207$, $p > .05$. Indeed, the correlation was significantly stronger for older adults than for young adults, one-tailed Fisher's $z' = 1.68$, $p < .05$.

Discussion

This study was intended to accomplish two main goals: to replicate the effect of belief bias, and to determine whether older adults' tendency towards biased reasoning is potentially attributable to differences in attitudes about reasoning, rather than differences in raw ability. While, contradicting the literature, neither goal was attained, unexpected findings in the data suggest interesting avenues for future confirmatory studies.

The data failed to conform to the literature suggesting that participants tend to evaluate the logic of arguments according to their agreement with its conclusion. Participants performed significantly better than chance, and bias scale and accuracy scores were neither significantly skewed nor leptokurtotic, so it is unlikely that any floor or ceiling effect is in play. A potential methodological issue may explain the anomaly, however. Because the logical structures of invalid arguments were generated randomly, many were very obviously invalid because they outright contradicted themselves or the positions implied by the conclusions. For instance, one item (which had a conclusion *in favor of* abortions) read, "All immoral things should not be illegal. All abortions are immoral. Therefore, some abortions should not be illegal." Indeed, this explanation is consistent with the data, given that participants were significantly more accurate for invalid syllogisms than for valid ones. Interestingly, this would constitute evidence against the selective scrutiny model; if participants evaluate only the conclusion of an argument, then whether the premises contradict the conclusion should have no effect, because the premises would not even be considered.

Even in the absence of an overall belief effect, the relatively high variability of bias scale scores indicated that individual differences were clearly important as to whether a given participant would be swayed by his or her beliefs, and indeed that was the case. The more conservative participants were, the less likely they were to be affected by the attempt at debiasing. To engage in post-hoc speculation, this would make sense—political conservatism is associated with fear of threat and resistance to change (Jost, Glaser, Sulloway, & Kruglanski, 2003), and participants in this study were essentially told, "You are biased; change." Follow-up research specifically investigating the link between political ideology (and its underlying personality traits and belief/attitudinal systems) and debiasing in the context of belief or myside bias would be called for.

Perhaps the most surprising result was the mixed age effect, in that older adults did not show more belief bias than young adults, in contrast with Klaczynski & Robinson (2000), but did show greater correspondence bias than young adults, consistent with Blanchard-Fields (1994). If it were true that older adults' reasoning is more biased because of diminished cognitive capacity in general, it would not follow this effect would extend to some contexts but not others. While these data clearly are not sufficient to insist that bias in older adults is not due to neural and cognitive decline, they do present an anomaly that that theory is ill-equipped to assimilate. To engage in nearly pure speculation, it would not be inconsistent with these results to suggest that older adults may retain their raw logical processing ability, but do not have the same checks as young adults against proceeding to use those logical conclusions to make judgments about individuals. This effect may not be specifically related to age, but instead cohort effects—it is not unreasonable to suggest that there are cultural differences in play, given the vigor with which young adults are now encouraged to avoid making individual social judgments based on

generalities.

Limitations and Future Directions

In addition to the potential methodological issues discussed above, there are several other limitations to the generalizability of this data that bear mentioning. First, sampling bias is a very real risk: convenience samples such as that used here are always suspect, and it is wholly possible that those older adults who would not only volunteer to take part in a cognitively demanding study but also see it through to the end might be among those who found the task easier—that is, those who would likely perform better.

Second, similarly, the use of an online survey such as this one—even one not publicly open—came at the cost of ensuring participants did not "cheat," and, again, there may be a difference between those who completed the survey and those who abandoned it. Given a sample size too low to satisfy assumptions for χ^2 analyses, there is little way to eliminate the possibility that such a difference would account for the effects or lack thereof seen here.

Third, it is possible that atmospheric effects muddied the analysis of the actual underlying cognitive mechanisms in play. For instance, even though the instructions for the AET emphasized the conditions for logical validity, participants still may have been unable to set aside their rejection of an argument with untrue premises. If the arguments had been presented in a form emphasizing the hypotheticality of the premises ("If it were true that [premises], then it would be true that [conclusion]"), then then fewer participants may have been influenced by their beliefs, regardless of the relevant individual differences. However, to do so would undermine the external validity of the task, given the relative scarcity of such tentative arguments in the real world.[3]

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[3] I am indebted to Richard B. Anderson (personal communication) for identifying this potential limitation.

Several future directions for research were identified above, but there are others which could be prompted by the results of the current study. Perhaps most intriguing would be to explore the specific characteristics of logical tasks at which young and older adults perform differently. The most pressing of these is to repeat the current study with specific "levels" of invalid arguments: those that are self-contradictory and those that are merely indeterminate. Additionally, some future study could explore within a single sample whether young adults and older adults come to similar logical conclusions, but older adults fail to stop short of making social judgments and applying those conclusions to individuals. Moreover, such a tendency could be compared to measures of explicit endorsement of the sort of Bayesian rationality this entails, which might shed light on whether any such relationship is due more to shared beliefs rather than merely biological age.

Conclusion

In summary, the findings in this study suggest that the assertion that older adults are categorically more prone to biased reasoning is suspect. While this study set out to replicate the effect of belief bias generally and to explore competing explanations for the phenomenon, the older adults studied did not show a significant difference in bias or instruction to avoid bias as compared to young adults, except when they were asked to extend the results of their reasoning to make a social judgment: estimating the political orientation of the argument writer. This challenges the belief that older adults are categorically more biased than young adults in their reasoning—future research should explore the contexts in which this is and is not the case. Unexpectedly, the data also indicated that participants' response to the manipulation depended on their political conservatism, to the exclusion of other factors. Additional research could begin to explore the facets of the broad construct of conservatism that interact with reasoning and,

similarly, in which contexts.

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Table 1

Bias Scale Scores and Accuracies

	Pre-Manipulation		Post-Manipulation		Average Difference	
Bias Scale Scores[a]						
Overall	*M* = 3.50	*SD* = 0.47	*M* = 3.53	*SD* = 0.51	*M* = -0.05	*SD* = 0.76
OA (*N* = 33)	*M* = 3.48	*SD* = 0.55	*M* = 3.56	*SD* = 0.55	*M* = -0.08	*SD* = 0.84
YA (*N* = 41)	*M* = 3.50	*SD* = 0.39	*M* = 3.51	*SD* = 3.56	*M* = -0.02	*SD* = 0.72
Accuracy[b]						
Overall	*M* = 10.22	*SD* = 2.32	*M* = 10.70	*SD* = 2.19	*M* = 0.49	*SD* = 2.72
OA (*N* = 33)	*M* = 10.94	*SD* = 2.32	*M* = 11.06	*SD* = 2.18	*M* = 0.12	*SD* = 2.23
YA (*N* = 41)	*M* = 9.63	*SD* = 2.17	*M* = 10.41	*SD* = 2.18	*M* = 0.78	*SD* = 2.55

Note: [a]A bias scale score of 3.5 is neutral. [b]An accuracy of 8 represents chance-level.

Figure 1. Sample AET item.

Please read the next set of instructions carefully!

People tend to view an argument as more logically valid if they already agree with its conclusion, regardless of whether or not it is actually valid. This tendency is called "belief bias." One of the goals of this study is to determine how well participants can avoid belief bias when instructed to do so.

Therefore, for the remainder of this task, please do your best to evaluate arguments ***only*** *as to their own logical validity.* ***Please try not to let your preexisting beliefs influence your responses.***

Type "Got it!" in the box below to continue. Remember, an argument is valid if, assuming the premises (or reasons given to support the conclusion) are true, its conclusion must also be true. It is not necessary for the premises to be true—only that, if they were true, the conclusion would also have to be true.

Figure 2. Manipulation instructions.

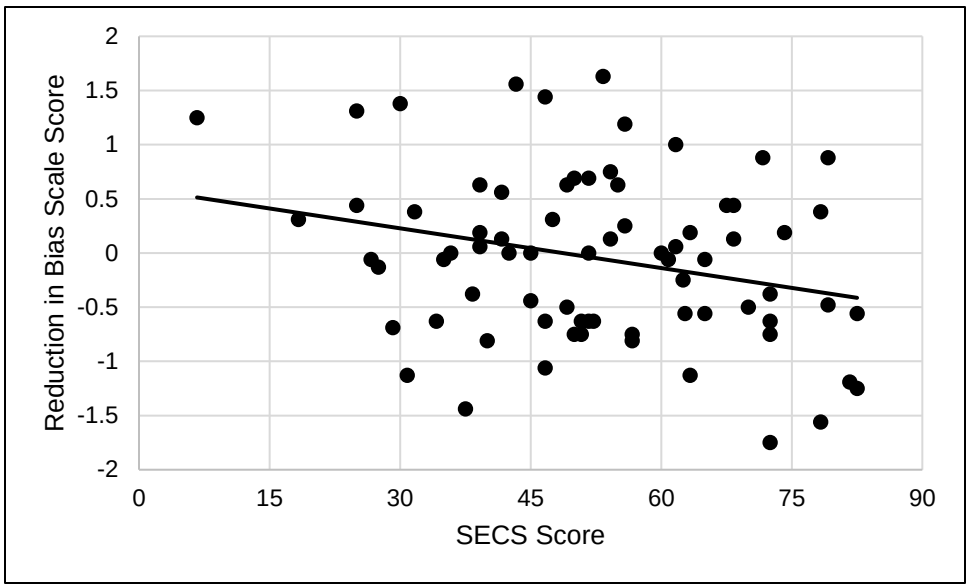

Figure 3. Post-manipulation bias scale score reduction by SECS score.