Shifting your opinion makes you change your factual beliefs without evidence

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Abstract

In two experiments, we experimentally manipulated people's subjective opinions about new wellness trends using positive clips from publicly available YouTube videos. Participants spontaneously judged novel statements that were consistent with their new opinion to be factual, despite the fact that they had encountered no evidence for any of the statements. Opinion change drove belief change, contradictory to the common assumption that facts determine opinions. Positive opinions also biased participants' curiosity such that they were highly motivated to learn more about opinion-congruent statements. In Study 2, participants reported false memories for the opinion-congruent statements within the video. These results illustrate the primary role of subjective opinions in belief formation about objective truths, and suggest that the eradication of misinformation is an incomplete solution for societal disagreements.

Keywords: opinion; belief change; curiosity; misinformation; false memory

Introduction

Misinformation and disinformation were recently named as the number one global threat to society over the next two years by the World Economic Forum (Global Risk Report, 2024). In line with this concern, research on misinformation has boomed in recent years. This work has focused on understanding how to correct people's beliefs by debunking or prebunking misinformation (e.g., Pennycook & Rand, 2021; Lewandowsky & van der Linden, 2021; Roozenbeek, Culloty & Suiter, 2023).

The literature's focus on correcting misinformation is built on two related assumptions. First, it is assumed that misinformation is a major cause of misinformed beliefs, rather than a symptom of existing biases. The narrow focus of the field on eradicating misinformation takes for granted that doing so would resolve misconceptions and change minds. Second, it is assumed that beliefs about facts are what determine people's opinions: if you make people's beliefs more accurate, then their opinions and behavioral intentions will naturally converge. Here, we investigate these assumptions.

False beliefs arise from many sources, of which misinformation is just one. This fact is sometimes lost in empirical papers about misinformation, which suggest human beliefs would be better if misinformation were eradicated. In this literature, virus metaphors like "infodemic" are common. They paint a picture of the human mind as a passive vector for "viral" falsities (Simon & Camargo, 2023), when psychology has established humans actively accept and reject information. For example, opinionated people actively seek out information that aligns with their intuitions, attitudes, and worldviews (Mercier, 2016). People selectively engage with information that feels good (Karlsson, Loewenstein & Seppi, 2009; Hertwig & Engel, 2016; Cogliati Dezza, Maher & Sharot, 2022), reflects well on themselves (Korn et al., 2012), signals important group memberships (Kahan, 2013; Funkhouser, 2017; Williams, 2021), or satisfies many other accuracy-independent goals (Sharot et al., 2023). Misinformation is therefore often consumed in active service of, i.e. as a *symptom* of, existing motivations and opinions; it "preaches to the choir" (Altay, Berriche & Acerbi, 2023). For example, exposure rates to anti-vaccination webpages are significantly higher among people who are already skeptical toward vaccines (Guess et al., 2020). Consistent with this pattern, a case study of extremist videos on YouTube found that engagement was driven by subscriptions and external links rather than algorithmic recommendations (Chen et al., 2023). The proliferation of misinformation can be seen as a marketplace of rationalizations, propped up by a demand for content that justifies opinions that people already hold (Williams, 2023).

Changing beliefs does not always change either opinions or behavior. Factual corrections to misinformation, even when successful in improving belief accuracy, often have small or nonexistent effects on attitudes and behaviors (Porter & Wood, 2024; Porter, Velez & Wood, 2023). A meta-analysis of eight multi-wave experiments testing a variety of political beliefs found that fact-checks on misinformation changed attitudes by less than half of a point on a 100-point feeling thermometer (Coppock et al., 2023). This finding dovetails with other work showing that changing voters' beliefs in objective facts about political candidates has no effect on their endorsements or voting preferences (Nyhan et al., 2019; Wu et al., 2022).

In sum, the focus on combating misinformation for improving the quality of human beliefs is misguided because it diminishes the role of pre-existing opinions and values in the belief formation process. This insight suggests that intervening on opinions themselves could represent an unexplored and potentially fruitful approach. By shifting people's subjective opinions, can we shift their beliefs about objective claims? For the sake of the present work, we define an opinion as a subjective, value-based judgment or view about a topic. We define a belief as a graded likelihood judgment of

a statement with an objective, testable truth.

Study 1

We experimentally manipulated participants' opinions by showing them a positive video about a relatively unknown topic. We tested whether this change in subjective opinion makes participants change their beliefs about novel, objective statements that are either positive or negative about the assigned topic. Crucially, these statements were fabricated and not mentioned or implied in the video at all. Finally, we investigated whether this opinion manipulation affects participants' curiosity about the statements.

Our design manipulated opinions directly rather than relying on existing differences in opinion or partisan allegiances. This is helpful because it avoids major confounds, e.g. in the information different groups are exposed to prior to the experiment, which would otherwise limit conclusions (Williams, 2023).

Method

Participants We recruited 100 participants through Prolific (www.prolific.com) to participate in a 16-minute online experiment. Participation was restricted to Americans fluent in English with a 95+% approval rate on previous submissions. Compensation was $10/hour.

Three participants were excluded for spending less than 7 minutes watching the 7-minute long video. An additional two participants were excluded for failing an attention check about the video they watched. These exclusions resulted in a final sample of N = 95.

Materials Participants rated 20 statements about two topics: float therapy and snail mucin. Float therapy, or restricted environmental stimulation therapy (REST), involves floating in a dark, soundproof tank or pod filled with salt water. Snail mucin is the slimy secretion that snails make. It is growing in popularity as an ingredient in skincare products. These topics were chosen because they are relatively new trends that participants are unlikely to have strong preexisting opinions about. All statements were fabricated but objective, theoretically testable statements about an effect of float therapy or snail mucin. For each topic, there were 5 positive statements (e.g., "Float therapy can boost creativity"; "Snail mucin can prevent melanoma, the deadliest skin cancer") and 5 negative statements (e.g., "Float therapy can increase the risk of developing schizophrenia", "Snail mucin can cause hormonal imbalances due to the presence of certain parabens").

Participants were randomly assigned to watch a video about one of the topics; statements about the unassigned topic served as controls. Videos were 7 minutes long and depicted float therapy and snail mucin positively without containing concrete information or evidence about their benefits. Each video comprised of clips from two publicly available YouTube videos: one formal introductory video and one unsponsored review video. The float therapy videos were "Well Tested: Flotation Therapy | Healthline" by Healthline and "I tried a Float Tank - sensory deprivation" by Laura Try. The snail mucin videos were "Harvesting Snail Slime for Beauty Products" by Great Big Story and "Viral Snail Mucin $\sim$ Get It Or Regret It! $\sim$ Tiktok Viral Skincare $\sim$ Over 50 Skincare" by Jenifer Jenkins. Clips of the videos were edited to remove any informational content that could be seen as relevant to any of the statements tested in the experiment.

Procedure Participants were randomly assigned to one of the two topics. First, they were asked their subjective opinion about their topic ("How do you feel about float therapy/snail mucin as a skincare product?") on a 0-100 scale, from strongly negative to strongly positive. Then, for each of the 20 test statements, participants rated how likely they believed the statement to be true on a 0-100 scale from definitely false to definitely true.

Participants then watched the video for their randomly assigned topic and re-rated their subjective opinion. Finally, in a second block, participants (1) re-rated how likely they thought each statement was true, and (2) rated how curious they were to learn more about the statement (0-100 scale, from not at all curious to extremely curious).

Results and Discussion

Subjective opinions about the assigned topic changed Participants' subjective opinions about their assigned topic became significantly more positive after watching the video (M = 69.73, SD = 27.63) compared to before the video (M = 50.56, SD = 30.06), $t(1899) = 33.97$, $p < .001$.

Participants' beliefs changed in favor of their subjective opinion in the absence of evidence Participants selectively increased their belief in positive statements about their assigned topic, and selectively decreased their belief in negative statements about their assigned topic (see Figure 1). These beliefs changed despite the fact that they were fabricated and were never mentioned in the video. We ran a linear mixed-effects model predicting belief change with trial condition (control vs. test) and statement type (positive vs. negative) as fixed effects and random intercepts per participant and item. This model revealed a significant effect of trial condition (β = -3.47, t = -2.86, p = .004), a significant effect of statement type (β = 4.11, t = 2.83, p = .007), and a significant interaction (β = 8.39, t = 4.88, $p < .001$).

When opinions changed more, beliefs changed more The more participants' subjective opinions changed, the more their factual beliefs changed in a way that was consistent with their opinions (see Figure 2). We ran a linear mixed-effects model predicting belief change in the test condition with statement type (positive vs. negative) and z-scored change in opinion as fixed effects, and random intercepts per participant and item. This model revealed a significant interaction between statement type and z-scored opinion change (β = 3.91, t = 2.93, p = .003), suggesting that higher changes in opinion corresponded to higher increases in belief for positive statements. There was no simple effect of z-scored attitude change

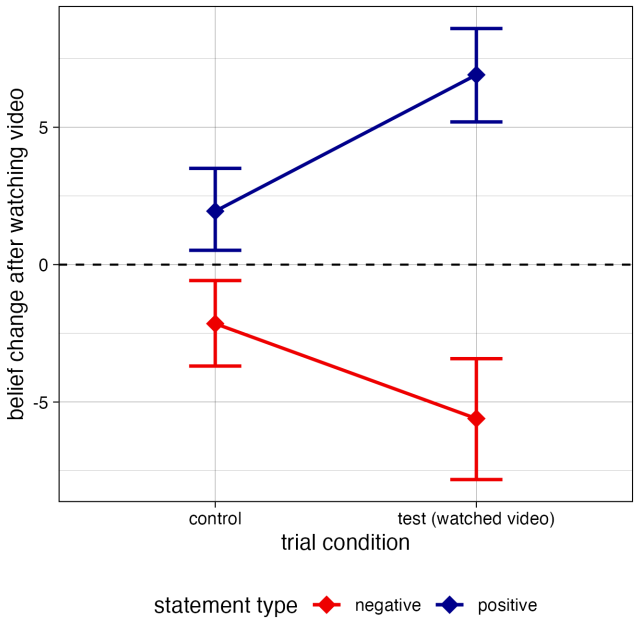

Figure 1: Participants increased their belief in supporting statements and decreased their belief in opposing statements related to their assigned topic, even though the videos contained no mention of, or evidence for, these statements. Diamonds are means and error bars are 95% bootstrapped CIs.

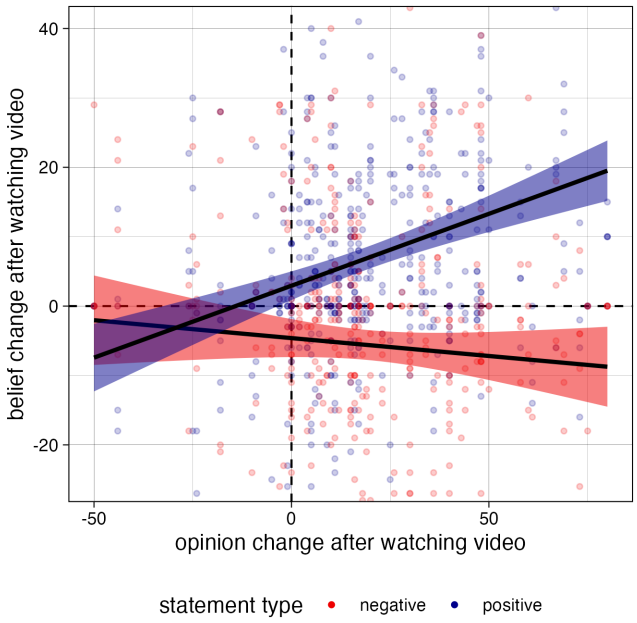

Figure 2: The more participants' subjective opinions changed, the more their objective beliefs changed in line with their opinions. Plot shows the test condition only, with linear regression lines per statement type shaded with 95% CIs.

in the control condition (p = 0.23), suggesting that the magnitude of opinion change primarily influenced beliefs in positive statements. However, our study may lack power to detect the negative relationship between opinion change and belief change for negative statements. Belief change was smaller in magnitude overall in the negative condition than the positive condition. This may be due to the illusory truth effect, where statements become more believable after repeated presentation (Dechene et al., 2010).

Participants may be selectively curious about statements that support their opinions We investigated how opinion change affected curiosity, which indexes which information participants would seek out in the future. We found that participants were more curious about statements related to the video they watched, and showed a general positivity bias such that they were more curious for positive statements about both topics. A linear mixed-effects model predicting curiosity to learn more about a statement, with trial condition (control vs. test) and statement type (negative vs. positive) as fixed effects and random intercepts per participant and item, revealed a significant effect of test condition (β = 3.91, t = 3.16, p = .002) and a significant effect of positive direction (β = 6.34, t = 4.08, $p < .001$). The interaction between trial condition and statement type was not significant (p = .60).

The finding that increased exposure to a relatively new topic induces curiosity is consistent with rational accounts of curiosity that emphasize utility (Dubey & Griffiths, 2020). This makes sense given that the information in the test items is relevant to direct actions participants could make to engage in these health and wellness fads. Higher curiosity for positive over negative items overall also mirrors prior work demonstrating a positivity bias in curiosity, which maximizes hedonic utility (Cogliati Dezza et al., 2022).

We predicted an interaction between trial condition and statement type such that participants would be more curious about positive statements in the test condition, and less curious about negative statements in the test condition, compared to controls. This prediction did not bear out in the data, but it's important to note that there can be multiple competing motives for curiosity (Sharot & Sunstein, 2020; Kobayashi et al., 2019; Molinaro et al., 2023). We cannot rule out the possibility that participants were curious about negative statements in the test condition because they were skeptical about them and were expecting to find flaws in the evidence opposing their opinion, for example.

As an exploratory analysis, we investigated the relationship between belief certainty and curiosity. In line with information-gap theory, we predicted that this relationship would be an inverted U-shaped curve, such that curiosity is highest at intermediate levels of certainty and lower when a learner either has no clue or is very confident in their answer (Loewenstein, 1994; Kidd & Hayden, 2015). This idea is supported by empirical work (e.g., Kang et al., 2009). To test this prediction, we operationalized certainty as the distance from the midpoint of the scale for participants' final belief

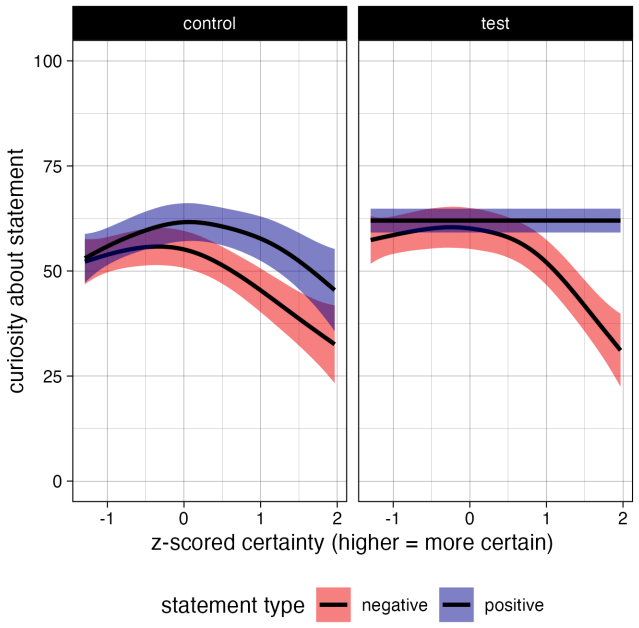

Figure 3: In the test condition only, curiosity about positive facts was uniformly high, regardless of certainty. Regression lines are smoothed using a generalized additive model and shaded with 95% CIs.

rating, as in prior work (Orticio, Martí & Kidd, 2022). We observed that z-scored certainty had a negative quadratic relationship to curiosity in all other conditions except for positive items in the test condition (see Figure 3). To probe this difference, we ran a linear mixed-effects model predicting curiosity in the test condition. As fixed effects, we included direction and z-scored, squared certainty. As random effects, we included intercepts per participant and item. The model revealed a significant effect of this quadratic certainty predictor for the negative items (β = -5.51, t = -5.98, $p < .001$), and a significant interaction between quadratic certainty and the positive condition (β = 5.18, t = 4.59, $p < .001$), such that this effect cancels out for positive items. Manipulating people's opinions about a topic may disrupt the relationship between belief certainty and curiosity such that curiosity is uniformly high, even for highly certain beliefs.

Study 2

Study 2 replicates our findings in a larger sample. It also includes an additional memory task component which achieves two main goals. First, it gives insight into the mechanism of belief change. Are participants making unjustified inferences about their assigned topic based on the very limited informational content of the video, or are they developing false memories that these fabricated statements were actually mentioned in the video? Second, it serves as a cover task to guard against demand characteristics. Participants were told that the experiment was a memory task and were instructed to pay attention because they would have to answer questions about the video. Participants should feel less demand to artificially change their beliefs under the guise of a memory task.

Method

Participants We recruited 200 new participants through Prolific (www.prolific.com) to participate in a 16-minute online experiment. Participation was restricted to Americans fluent in English with a 95+% approval rate on previous submissions. Compensation was $10/hour.

Six participants were excluded for failing an audio check, another 6 for spending insufficient time to watch the full video, and another 7 for failing an attention check about the video they watched. These exclusions resulted in a final sample of N = 181.

Materials and Procedure As in Study 1, there were 5 positive, fabricated statements for each topic. In addition, there were 3 memory control statements for each topic which were mentioned in the videos (e.g., "Float therapy simulates the feeling of weightlessness using water containing epsom salt"; "Snail mucin can be extracted by spraying snails with a pleasant spray"). Thus, participants rated 16 statements in total. The videos were identical to Study 1.

The procedure was identical to Study 1 aside from two main changes. First, before watching the video, participants were told that they were completing a memory task were advised to pay attention because they would later answer questions about the video. They were also told that good performance would be rewarded with a cash bonus. Second, in the second block of ratings after watching the video, participants were asked whether each statement was mentioned in the video that they watched and provided a yes or no response.

Results and Discussion

Participants' subjective opinions about their assigned topic became significantly more positive after watching the video (M = 77.66, SD = 22.43) compared to before the video (M = 48.72, SD = 25.65), $t(2895) = 62.93$, $p < .001$.

As in Study 1, participants endorsed completely fabricated, objective beliefs about their assigned topic more strongly after watching a generically positive video. We ran a linear mixed-effects model predicting belief change with trial condition (control vs. test) and memory condition (fabricated vs. mentioned in video) as fixed effects, and random intercepts per participant and item. The model revealed a significant effect of test condition (β = 5.32, t = 5.76, $p < .001$) and a significant interaction between trial condition and memory condition (β = 22.18, t = 14.70, $p < .001$). Belief in the test items increased, while belief in control items remained stable. Within the test condition, participants' beliefs changed even more for items that were explicitly mentioned in the video than for fabricated items, as expected.

Opinion change after watching the video remained a significant predictor of belief change for fabricated items in the test condition. We ran a linear mixed-effects model predict-

ing belief change for fabricated items in the test condition with z-scored change in opinion as a fixed effect and random intercepts per participant and item. We found a significant effect of z-scored change in opinion ($\beta = 5.67$, $t = 4.70$, $p < .001$), indicating that when participants' subjective opinions shifted more, their objective beliefs in the fabricated items also changed more in the same direction.

Curiosity was higher for items in the test condition, i.e., items related to the assigned topic. In addition, participants whose opinions changed more after watching the video were more curious, especially for items related to the video they watched. We ran a linear mixed-effects regression model predicting curiosity with trial condition and z-scored opinion change as fixed effects and intercepts per participant and item as random effects. The model revealed a significant effect of test condition ($\beta = 5.32$, $t = 5.76$, $p < .001$), a significant effect of opinion change ($\beta = 3.48$, $t = 2.12$, $p = .04$), and a significant interaction ($\beta = 3.18$, $t = 4.33$, $p < .001$). The simple effect of opinion change suggests that those are generally more receptive to changing their opinion about their assigned topic are broadly more curious. On top of this effect, the interaction suggests that having a more positive opinion about a topic increased participants' curiosity for positive statements about that topic.

Participants reported false memories for fabricated statements Overall, participants performed significantly above chance at remembering items that were mentioned in their assigned video (memory control condition, 90.4% of trials, exact binomial p <.001), and correctly *not* remembering items that were about the other topic (unassigned topic condition, 6.6% of trials, exact binomial p <.001). In addition, participants reported false memories for the fabricated items on 22.2% of trials overall (see Figure 4). At least one false memory (of a possible 5) was reported by 44.2% of participants.

We ran a mixed-effects logistic regression model predicting reported memory for a statement within the video, with memory condition (unassigned topic vs. memory control vs. memory test) as a fixed effect and random intercepts per participant and item. This model revealed significant effects of the memory control condition ($\beta = 7.40$, $z = 22.63$, $p < .001$) and the memory test condition ($\beta = 2.27$, $z = 11.33$, $p < .001$), and all pairwise comparisons were statistically significant (p's < .001). Thus, false memories for the fabricated facts in the test condition were significantly more common than reported memories for facts in the unassigned topic, but less common than accurate memories for facts that were mentioned in the video. False memories provide a potential mechanism for belief change and speak against a mere inferential account.

False memories are predicted by higher belief change and higher curiosity False memories are more common for statements that participants had changed their beliefs about more and for statements that participants were more curious about. We ran a mixed-effects logistic regression model to predict (false) memories for fabricated items only. As fixed

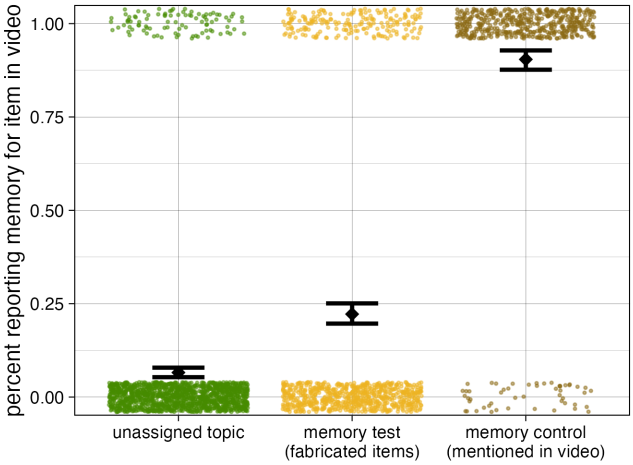

Figure 4: Participants reported false memories for fabricated items on 22.2% of trials (memory test condition). Dots are individual data points, diamonds are means, and error bars are 95% bootstrapped CIs.

effects, we included trial condition (control, unassigned topic vs. test, assigned topic), z-scored belief change, z-scored opinion change, and z-scored curiosity. As random effects, we included intercepts per item. The model revealed a significant effect of test condition ($\beta = 1.26$, $z = 6.68$, $p < .001$), a significant effect of belief change ($\beta = 0.87$, $z = 6.00$, $p < .001$), and a significant effect of curiosity ($\beta = 0.38$, $z = 2.50$, $p = .01$). Opinion change was not a significant predictor ($p = 0.14$), and and none of the continuous predictors interacted with trial condition. Participants were more likely to report false memories for a statement when their belief for that statement increased more and when they were more curious to learn more about that statement. Surprisingly, participants who had changed their opinion about their assigned topic more were not more likely to have false memories after controlling for belief change and curiosity. This null finding may indicate that memory judgments do not interact directly with shifts in opinion. However, prior work has found false memories in more political domains to be predicted by strength of partisan attachments (Armaly & Enders, 2023), so it's possible that a similar relationship could emerge if testing less neutral topics.

General Discussion

Across two experiments, we showed participants a positive video to experimentally manipulate their subjective opinions about a topic, and found that they selectively changed their beliefs about factual statements to align with their opinion. For example, after watching brief YouTube clips showing how snail mucin is extracted and used in beauty products, participants more strongly endorsed opinion-congruent beliefs like "Snail mucin can treat discoloration of the skin by interfering with excess melanin production", and reduced their

belief in opinion-incongruent statements like "Snail mucin can trigger malassezia folliculitis, or fungal acne". Belief change occurred even though the videos contained absolutely no mention or evidence for any of the tested statements. Further, belief change was more dramatic for participants whose subjective opinions shifted more as a result of our manipulation, supporting the idea that it's the change in opinion that drives subsequent belief change. **While a large and influential literature assumes that the route to changing people's minds is to counter misinformation and improve their beliefs, we show that this relationship can also work in reverse: shifts in opinion can alter your assessment of facts in the absence of evidence.**

Study 2 highlights a potential mechanism for this belief change: many participants reported false memories that these statements were actually featured in the videos they watched. The rate of false memories for these entirely fabricated statements was notable: they were reported on almost a quarter of possible trials overall, and nearly half of participants reported at least one. False memories were more likely to occur when a participant's belief in a statement had changed and when they reported high curiosity to learn more about the statement. Source misattributions occurred despite a monetary incentive to perform well in the memory task. We cannot completely rule out the possibility that participants were merely making dubious inferential leaps based on the limited information in the videos. However, participants seemingly attributed some of their belief change to (non-existent) content from the video, thus maintaining an "illusion of objectivity" (Pyszczynski & Greenberg, 1987), a signature of motivated cognition (Kunda, 1990). It's possible that participants arrived at these false memories by implicitly reasoning backwards from their change in opinion (Hemmer & Steyvers, 2009). A potential consequence of these false memories is that a person who holds them may be more resistant to subsequent changes in their belief if they erroneously believe it to be formed on the basis of evidence.

We find suggestive evidence in Study 1 that curiosity was not purely dictated by informational uncertainty, as rational accounts would predict. Curiosity for opinion-congruent statements in the test condition was uniformly high, even in instances of high certainty. Speculatively, participants who are curious about beliefs that they already hold with high certainty may be motivated to gather more evidence to justify their opinions (Mercier, 2016). In more politicized or morally charged domains, where it may be more relevant to signal group membership than to form accurate, action-oriented beliefs (Funkhouser, 2017; Williams, 2021), curiosity may be biased even more strongly. Indeed, people readily condone motivated reasoning when it's morally desirable (Cusimano & Lombrozo, 2023). However, as this analysis was post-hoc, future work should clarify the relationship between certainty and curiosity, ideally using a subjective, self-reported measure of belief certainty in addition to our approximate measure.

Conclusion

We show that shifting someone's subjective opinion can make them spontaneously change their beliefs in objective facts to be more congruent with their opinion, even without providing any direct evidence for, or even mentioning, those beliefs. We obtain these results using an ecologically valid task involving excerpts from real YouTube videos which you might naturalistically encounter if you became curious about a topic and searched for it online. This is the first work to our knowledge which demonstrates that changing subjective opinions can have a biasing influence not only on information-seeking behavior, but directly on beliefs about objective facts themselves. A key implication is that efforts to counter misinformation are an incomplete solution for societal disagreements because people's beliefs tend to align with how they already feel. Instead, more intervention efforts should be focused on the much harder challenge of addressing the root causes of disagreement and institutional distrust that drive people to consume misinformation in the first place.

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