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Social Psychology

The Effect of Brooding About Societal Problems on Conspiracy Beliefs: A Registered Report

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This Stage 2 Registered Report concerns the relationship between rumination, a repetitive style of negative thinking, and conspiracy beliefs (Stage 1 protocol: https://osf.io/y82bs, date of in-principle-acceptance: 23/05/2023). Based on four pilot studies, we tested in a fifth, registered study whether brooding, a particularly dysfunctional form of rumination, contributes to conspiracy beliefs using a repeated-measures within-person experiment (N = 1,638). Mean difference scores (conspiracy beliefs at T2 minus conspiracy beliefs at T1) were significantly greater in the brooding condition than in the control condition. However, we could neither confirm that this effect was larger than the specified smallest effect size of interest of d = 0.20, nor conclude that it was too small to be of interest (i.e., smaller than d = 0.20). We explored how reflection, an analytic form of rumination, impacted conspiracy beliefs. We further discuss implications for theories about the formation of conspiracy beliefs, and efforts aimed at preventing or reducing unfounded conspiracy beliefs. Hopefully, this article sparks a discussion among conspiracy belief researchers about how smallest effect sizes of interest could be determined in a principled way based on real-world outcomes.

Worrisome events are all over the news: Reports about multiple societal crises, such as the COVID-19 pandemic, war, climate change, and political division, dominate the current information landscape (Gabbatiss, 2019; Grynspan, 2022; United Nations, 2022). When exposed to such distressing information, people may respond in various ways. They may accept or reappraise the situation, avoid the stressor, or engage in dysfunctional rumination. Here, we focus on the consequences of dysfunctional rumination about worrisome societal events. Rumination is a style of thinking that is repetitive, difficult to disengage from, and focused on negative content (Ehring & Watkins, 2008; Nolen-Hoeksema et al., 2008). It consists of repeatedly asking oneself "why" and "what if" types of questions in an unproductive manner (Zetsche et al., 2009). A large body of evidence links rumination to negative affect, depression and other undesirable psychological consequences (Lyubomirsky & Tkach, 2004).

This research program investigates how rumination may affect the formation of conspiracy beliefs. Several theories about the formation of conspiracy beliefs predict that rumination should increase the tendency to believe in conspiracies, e.g., via negative affect or negative attention and interpretation biases. Below, we describe these theories, and outline the rationale for our pilot studies (one observational, three experimental), which investigated the causal link from rumination to conspiracy beliefs. Based on these pilot studies, we outline subsequently that rumination needs to be further differentiated: Whereas reflection is a deliberate and analytic form of rumination, brooding consists of dwelling on negative thoughts and emotions. This Registered Report tests the hypothesis that specifically the brooding subtype of rumination increases conspiracy beliefs.

Defining Conspiracy Beliefs

A conspiracy is a secret plot by a powerful group that aims to achieve a common goal. Importantly, the conspirators pursue this goal regardless of the consequences for others: Malicious intentions are not required, but the goal is pursued even if this harms others. Thus, conspiracies tend to have harmful consequences for many people (Douglas & Sutton, 2023). A conspiracy belief is the conviction that a conspiracy has taken (or is currently taking) place (Douglas et al., 2019). Some well-known examples include the belief that Bill Gates is using the Coronavirus vaccines as a ploy to gain control over the world population, or

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that the American government was responsible for the 9/11 terrorist attacks. There are other conspiracy beliefs that many would consider more plausible, such as beliefs about the tobacco industry having concealed evidence (Francey & Chapman, 2000), or the Volkswagen emissions scandal (where the corporation eventually plead guilty to charges of conspiracy, Carey, 2017).

Understanding causes and enabling conditions of conspiracy beliefs is important. It lies in the public interest to disprove false, and uncover true conspiracies, particularly because conspiracy beliefs can have harmful consequences for individuals and societies: they negatively affect psychological well-being (Leibovitz et al., 2021; Liekefett et al., 2021), and decrease institutional trust, societal engagement, as well as compliance with important health behaviors (Bertin et al., 2020; Hornsey et al., 2020; Jolley & Douglas, 2014; Pummerer et al., 2020; van Mulukom et al., 2022). So, arguably, it would be ideal if people only believed in conspiracies that actually took place and not in any that did not take place. For the present purposes, however, we do not differentiate between true and false, or plausible and implausible conspiracy beliefs. We focus entirely on subjective beliefs that fulfill the criteria of a conspiracy belief. That is, we consider conspiracy beliefs as a superordinate category that may entail both warranted and unwarranted beliefs (Nera & Schöpfer, 2022).

Possible Pathways from Rumination to Conspiracy Beliefs

Several theories on the formation of conspiracy beliefs, as well as on the consequences of rumination, imply that rumination should increase conspiracy beliefs. In this section, we summarize these theories and their predictions. Our goal is not to test these models against each other, or to identify the specific pathways through which rumination impacts conspiracy beliefs. Instead, our goal is to show that multiple theoretical approaches would suggest a causal link from rumination to conspiracy beliefs.

Rumination, Negative Affect and Conspiracy Beliefs

Current theories about the formation of conspiracy beliefs suggest that they result, at least in part, from the experience of negative affect. In a highly influential review paper, Douglas et al. (2017) argue that conspiracy beliefs emerge when people's fundamental needs for security, certainty, and belonging are frustrated. Such negative affective states make conspiracy beliefs appear attractive: Conspiracy beliefs offer ostensibly simple answers to complex questions, allow to shift the blame to clearly identified enemies, and provide a positive image of the self and ingroup (Douglas et al., 2017). In a similar vein, the existential threat model of conspiracy theories suggests that existential threat, defined as feelings of anxiety and uncertainty, is at the root of conspiracy beliefs (van Prooijen, 2020). Existential threat prompts a sense-making process in which people aim to identify simple causal relations between and explanations for phenomena. When antagonistic outgroups that can be blamed for social problems are present, this sense-making process leads to conspiracy beliefs (van Prooijen, 2020). So, according to both Douglas et al. (2017) and van Prooijen (2020), experiencing negative affect is conducive to the formation of conspiracy beliefs.

Crucially, it is well-established that rumination in response to distress increases negative affect. Rumination has been described as an "emotional magnifier" that amplifies existing negative affective states (Watkins & Roberts, 2020, p. 2). A number of experiments have shown that ruminating about distressing events prolongs negative mood. These studies have typically used a repeated measures design in which a rumination condition was compared to a distraction condition, and negative affect was measured before and after the manipulation. In a comprehensive review of research on the link between rumination and negative affect, Kirkegaard Thomsen (2006) concludes that 15 out of 20 studies that used such a design found the predicted group difference between rumination and distraction, two reported a trend in the expected direction, and three reported null results (which may, in part, be attributable to a failed manipulation). However, these studies did not examine whether effects resulted from an increase in negative affect due to rumination, or a decrease due to distraction (Kirkegaard Thomsen, 2006). As such, one can conclude that rumination increases negative affect compared to distraction, while its effects alone are less well studied experimentally.

Beyond these experimental results, a number of longitudinal studies provide evidence for a link between rumination and negative affect: the tendency to ruminate has consistently been found to predict longer and more severe periods of depression at a later time (Nolen-Hoeksema et al., 1994, 1997). Similarly, a recent experience-sampling study found evidence for a reciprocal relation between rumination and negative affect: within-person increases in rumination predicted subsequent within-person increases in negative affect, and vice versa (Blanke et al., 2022). Converging findings have been obtained by researchers using similar designs (Brans et al., 2013; Lennarz et al., 2019; Moberly & Watkins, 2008; Pavani et al., 2017).

Taken together, rumination and negative emotion appear to reinforce each other in a vicious cycle (Lyubomirsky & Tkach, 2004). Given that theories on the formation of conspiracy beliefs state that they are more likely to emerge when people experience negative affect (Douglas et al., 2017; van Prooijen, 2020; van Prooijen & Douglas, 2018), rumination in response to distressing events should increase conspiracy beliefs. A similar line of thought can be found in recent research that suggests that emotion dysregulation, which is a general inability to regulate negative emotions, is correlated with conspiracy beliefs (Molenda et al., 2023; Scandurra et al., 2022). The following mechanism is proposed: Dysfunctional emotion regulation results in negative affect which, in turn, leads people to interpret ambiguous stimuli as threatening and hostile. This bias, in turn, contributes to the adoption of conspiracy beliefs (Molenda et al., 2023). Since rumination is a dysfunctional emotion regulation strategy (Aldao et al., 2010), the

same argument can be applied to justify the effect of rumination on conspiracy beliefs.

Rumination, Negative Cognitive Biases, and Conspiracy Beliefs

Research demonstrates that rumination leads to negatively biased thinking (Lyubomirsky & Tkach, 2004). For example, experiments have shown that dysphoric participants induced to ruminate made more pessimistic attributions about upsetting experiences, made more negative predictions about future events, retrieved more negative memories from their past, and judged negative events as having occurred more frequently that dysphoric individuals that were distracted (Lyubomirsky et al., 1999; Lyubomirsky & Nolen-Hoeksema, 1995). A more recent study using a thinking-aloud paradigm further found that participants with higher trait rumination scores (specifically, trait brooding scores) demonstrated longer periods of negative thoughts in a resting state, and their negative thoughts were linked to a stronger narrowing in conceptual scope over time, as indicated by higher semantic similarity (Raffaelli et al., 2021). This converges with Andrews-Hanna et al. (2022)'s finding that, during a free association task, trait ruminators are more strongly attracted to negative conceptual spaces and more likely to remain there longer.

Conspiracy beliefs are negative explanations of often ambiguous, meaningful events: powerful groups or individuals that act in secret are made responsible for societal problems. Therefore, the negative attention and interpretation biases induced by rumination can be expected to contribute to conspiracy beliefs. In line with this, recent research has shown that conspiracy beliefs are related to a general suspicious processing style, that is, an intuitive tendency to perceive negative intentionality and secrecy in both conspiracy-related and -unrelated events (Frenken & Imhoff, 2022). Further, conspiracy beliefs are associated with several other thinking biases, such as the tendency to attribute agency and intentionality to inanimate objects (Douglas et al., 2016). An anxious attachment style, which entails an exaggerated perception of threat and a negatively biased view of others, has also been found to predict conspiracy beliefs (Green & Douglas, 2018). These findings show that styles of thinking that share properties with rumination contribute to the formation of conspiracy beliefs.

Analogous Evidence from Research on Persecutory Delusions

Lastly, rumination has been identified as an important precursor of persecutory delusions, defined as false beliefs about a malevolent persecutor who intends to commit harm (Westermann & Lincoln, 2011). Several studies provide evidence for an association between rumination (or closely related forms of repetitive negative thinking, such as worrying) and persecutory delusions (Freeman et al., 2008; Freeman & Garety, 2014; Hepworth et al., 2011; Ludwig et al., 2020; Martinelli et al., 2013; McKie et al., 2017). Importantly, the presence of worry predicts delusional episodes longitudinally (Freeman et al., 2012), and interventions targeting a worry thinking style were effective in reducing persecutory delusions, which provides evidence for a causal relationship (Foster et al., 2010; Freeman et al., 2015). The suggested causal mechanism again refers to a narrowing of attention to negative stimuli, and subsequent threat-related interpretation biases. These biases prevent the consideration of non-threatening information that could potentially disprove the delusion (e.g., Bortolon & Raffard, 2021).

Importantly, we do not equate conspiracy beliefs with persecutory delusions: Persecutory delusions are a form of psychopathology and conspiracy beliefs are not. Nonetheless, similar to persecutory delusions, conspiracy beliefs entail the conviction that harm is going to occur (or already has occurred), and that a threatening agent (persecutor or group of conspirators) will cause (or already has caused) harm (Freeman, 2007).[1] Further, both conspiracy beliefs and persecutory delusions are firmly held, resistant to change, and highly distressing (Douglas et al., 2019; Freeman, 2007). Because of these substantial similarities, it appears worthwhile to investigate whether they may be enabled by analogous conditions and brought about by analogous causes. This kind of analogous reasoning has previously been used to motivate research on the link between narcissism and conspiracy belief (Cichocka et al., 2016).

Preliminary Predictions for the Current Research

In sum, major theories directly concerned with the formation of conspiracy beliefs, combined with theories on the affective and cognitive consequences of rumination, strongly imply that rumination should increase the likelihood of conspiracy beliefs. Further support for this idea comes from research on persecutory delusions, which share key characteristics with conspiracy beliefs.

Pilot Studies

We conducted four pilot studies to test the causal role of rumination (broadly conceived) in conspiracy beliefs. Pilot Study 1 tests the idea that the habitual tendency to ruminate is correlated with conspiracy beliefs. Pilot Studies 2a and 2b aimed to test the causal effect of experimentally induced rumination on conspiracy beliefs using hypothetical scenarios. Pilot Study 3 aimed to test the causal effect of rumination on conspiracy beliefs using real-world issues that were dynamically matched to participants based on which issue caused them the most concern. All Pilot Studies were administered in German language, and sampled par-

1 Please note that not all conspiracy beliefs contain an anticipation of harm. Some are conspiratorial interpretations of ongoing or past events (e.g., 9/11 conspiracy beliefs).

Table 1. Bivariate correlations between conspiracy beliefs and rumination Pilot Study 1

	M	*SD*	1	2	3	4	5
1 – Conspiracy Mentality Questionnaire	4.00	1.58	1				
2 – Generic Conspiracist Belief Scale	2.99	1.58	.82**	1			
3 – Flexible Inventory of Conspiracy Suspicions	3.49	1.84	.79**	.74**	1		
4 – Perseverative Thinking Questionnaire	3.49	1.34	**.26****	**.27****	**.19****	1	
5 – Rumination Subscale	4.09	1.21	**.22****	**.17***	**.16***	.64**	1

Note. *p < .050, **p < .010; correlations between rumination and conspiracy beliefs are in bold.

ticipants that currently live in Germany and speak German fluently. The samples and results from all Pilot Studies are described in detail in the Supplement: https://osf.io/rdpz4/

Pilot Study 1

Pilot Study 1 (218 participants, recruited by the survey company respondi) tested correlations between two rumination measures (the Perseverative Thinking Questionnaire [PTQ], Ehring et al., 2011, and the Rumination Subscale of the Heidelberg Form of Emotion Regulation Strategies [HFERST], Izadpanah et al., 2019) and three conspiracy belief measures (Brotherton et al., 2013; Bruder et al., 2013; Wood, 2017). Both rumination scales measure the broad tendency to engage in repetitive negative thinking. The PTQ focusses on the general characteristics of the thinking process (i.e., whether it is repetitive, unproductive, and/or intrusive), whereas the rumination subscale of the HFERST refers specifically to distressing events and ruminating about the causes of one's negative emotions.

Pilot Study 1 was preregistered (https://aspredicted.org/77Y_QYF). Any deviations from the preregistration are described in the Supplement. Results demonstrated that both rumination measures were significantly correlated with all conspiracy belief measures (see Table 1).[2] This supports the idea that the tendency to ruminate is related to conspiracy beliefs.[3]

Pilot Studies 2a and 2b

Pilot Studies 2a (N = 401) and 2b (N = 249, both recruited by respondi) aimed to test the causal effect of rumination on conspiracy beliefs using hypothetical scenarios, i.e., mock newspaper articles that raised the possibility of a conspiracy. In Pilot Study 2a, two scenarios were used: The first referred to claims about social media corporations wiretapping users' smartphones in secret for personal gains (social media scenario), the second described a controversial politician dying in a plane crash (plane crash scenario). In Pilot Study 2b, only the social media scenario was used. For each scenario, participants were randomly assigned to a rumination or a control condition. In the rumination condition, participants were asked to repeatedly think about and write down their thoughts and concerns about the events described in the scenario. Conspiracy beliefs and non-conspiratorial explanations about the scenario were measured, and participants indicated the extent to which they ruminated as a manipulation check (see Table 2).

Pilot Studies 2a and 2b were preregistered (Pilot 2a: https://aspredicted.org/CPG_NW2, Pilot 2b: https://aspredicted.org/16G_642). Any deviations from the preregistration are described in the Supplement. Results revealed that, in the social media scenario of Pilot Study 2a, rumination was successfully induced (d = 0.25).[4] As predicted, the rumination condition also scored significantly higher on conspiracy beliefs than the control group (d = 0.39). However, in the plane crash scenario of Pilot Study 2a (d = 0.16), and in the social media scenario of Pilot Study 2b (d = 0.16), we failed to successfully induce rumination. In both cases, we found no evidence that participants in the rumination condition ruminated significantly more or more intensely than those in the control group, which precluded a meaningful test of our hypothesis. We further did not find any statistically significant differences in conspiracy beliefs between the conditions (d Pilot Study 2a = 0.13, d Pilot Study 2b = -.01).

However, in all scenarios of these pilot experiments, the extent to which participants ruminated during the manipulation (i.e., the manipulation check) was positively correlated with conspiracy beliefs (r's between .34 and .57). This suggests that not only habitual rumination, but also the spontaneous use of rumination in an experimental setting

2 These correlations remain significant using Holm (1979) or Hommel (1988) correction for multiple testing. Using a Bonferroni correction, the two smallest correlations fail to reach significance. However, it can be argued that no correction for multiple testing is necessary: To confirm our expectation, all correlations between rumination and conspiracy beliefs need to be significant, not only one of them.

3 Note that, given our sample size, the achieved power for some of these correlations (assuming that they reflect the true correlation) was not that high (e.g., we would have had a power of 66% for a correlation of .16 with alpha = 0.05). Future research attempting to replicate these correlations should ideally use larger samples.

4 Note that the p-value for this one-sided test was close to .05 (specifically, .048), and can thus only provide tentative evidence of a successful manipulation (Benjamin et al. (2018).

Table 2. Descriptive Statistics per Condition Pilot Studies 2a and 2b

Pilot Study 2a			
Scenario 1 (Social Media)			
	Total (*N* = 193), *M (SD)*	Rumination (*n* = 82), *M (SD)*	Control (*n* = 111), *M (SD)*
State Rumination	3.00 (1.34)	3.19 (1.37)	2.86 (1.30)
Conspiracy Beliefs	3.60 (1.55)	3.94 (1.60)	3.35 (1.47)
Non-Conspiratorial Explanations	4.70 (1.37)	4.52 (1.52)	4.84 (1.24)
Scenario 2 (Plane Crash)			
	Total (*N* = 208), *M (SD)*	Rumination (*n* = 78), *M (SD)*	Control (*n* = 130), *M (SD)*
State Rumination	2.62 (1.40)	2.76 (1.51)	2.54 (1.33)
Conspiracy Beliefs	3.19 (1.68)	3.32 (1.79)	3.10 (1.60)
Non-Conspiratorial Explanations	4.55 (1.55)	4.35 (1.75)	4.67 (1.41)
Pilot Study 2b: Scenario 1 (Social Media)			
	Total (*N* = 228), *M (SD)*	Rumination (*n* = 101), *M (SD)*	Control (*n* = 127), *M (SD)*
State Rumination	2.87 (1.65)	3.02 (1.71)	2.75 (1.59)
Conspiracy Beliefs	3.45 (1.68)	3.44 (1.76)	3.46 (1.63)
Non-Conspiratorial Explanations	4.85 (1.38)	4.96 (1.45)	4.75 (1.31)

Note. All items were answered on a 7-point Likert scale.

is correlated with conspiracy beliefs. Nevertheless, these results cannot provide evidence for a causal relationship. It may be that unobserved confounding variables that are related to both state rumination and conspiracy beliefs introduced a spurious correlation (Bollen, 1989).

Pilot Study 3

Overall, the results of Pilot Studies 2a and 2b highlighted the necessity to reconceptualize the experiment, especially since we failed to reliably induce rumination. First, our manipulation was considerably shorter than those typically used in clinical research. Second, the hypothetical scenarios may not have been considered real and/or worrisome by all participants. This may have resulted in a failure to induce rumination, or in effects that, assuming a monotonic dose-response relationship, were too small to be detected with adequate power. For these reasons, we designed a new rumination manipulation that was a) considerably longer and b) focused on real-world issues that caused actual worries to our participants. Participants were randomly assigned to rumination and control conditions, and were dynamically matched with the societal topic (out of a list of six topics, e.g., growing gap between rich and poor) that caused them the most concern. The list of the six topics was based on a pre-test: We selected topics that were worrisome to our participant pool and allowed for the interpretation of a conspiracy (see Supplement for details).

Results from Pilot Study 3 (*N* = 297, recruited from Prolific) revealed that this strategy was successful: The new rumination condition scored consistently and significantly higher than the control group on an entire range of manipulation checks (e.g., estimated and subjective length of time spent ruminating, intensity of rumination, thoughts growing more and more negative, perceived increases in frustration and negative mood). However, conspiracy beliefs were not affected in the theoretically expected direction (d = -0.05). An equivalence test, which examines whether effects larger than a specified smallest effect size can be rejected (for details, see below) revealed that an effect larger than d = 0.20 could be rejected (p = .034, see Figure 1). Assuming d = 0.20 as the smallest effect size of interest (for a justification of this smallest effect size of interest, see below), we can conclude that rumination did not meaningfully increase conspiracy beliefs. Nevertheless, conspiracy beliefs were again significantly correlated with a variety of manipulation checks (e.g., intensity of rumination, thoughts growing more and more negative, negative mood and frustration, r ranging from .22 to .37; although conspiracy beliefs were not significantly correlated with estimated and subjective length of time spent ruminating). It must be considered that these correlations may be due to the influence of third variables that are related to both the predictor and the outcome but not included in the current model.

Insights from Pilot Studies

Overall, our Pilot Studies produced an inconclusive pattern of results. Out of two experiments that successfully induced rumination, only one showed the predicted effect on conspiracy beliefs (Pilot Study 2a, social media scenario). Pilot Study 3 provided evidence against the hypothesis that rumination increases conspiracy beliefs: Although rumination was successfully induced, conspiracy beliefs did not meaningfully increase (assuming d = 0.20 as the smallest effect size of interest). Our Pilot Studies provide several valuable insights for our Registered Report. First, Pilot Study 3 demonstrated that using real-world issues that are

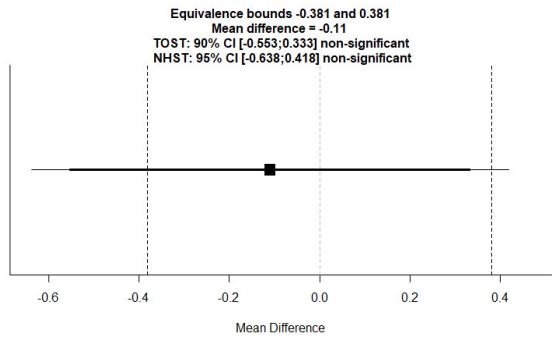

Figure 1. Equivalence Bounds for Key Hypothesis Test

Note. On the x-axis, unstandardized mean differences are depicted. The dashed vertical lines indicate the equivalence interval. The bold horizontal line indicates the 90% CI.

dynamically matched to participants is an effective procedure for inducing rumination. Second, they provide reason to suspect that rumination broadly conceived does not reliably impact conspiracy beliefs. A more fine-grained understanding of rumination may be necessary (see below). Lastly, our Pilot Studies are limited in that they only examined between-person effects. Yet the predicted effect explicitly takes place at the within-person level: If a person ruminates, that same person is thought to be more likely to believe in a conspiracy subsequently. Since between-person data are limited with regard to the evaluation of within-person hypotheses (Curran & Bauer, 2011), we plan to include within-person measures of change in the Registered Report.

Two Subtypes of Rumination: Brooding and Reflection

Although initially thought of as a unitary construct (e.g., Lyubomirsky & Nolen-Hoeksema, 1995), advances in research on rumination suggest the existence of at least two subtypes: reflection and brooding (Treynor et al., 2003). Reflection is defined as a purposeful style of thinking aimed at cognitive problem solving, and brooding as a passive, unproductive dwelling on negative information (Armey et al., 2009; Treynor et al., 2003). More recent definitions state that reflection is purposeful, self-distanced, and solution-focused, whereas brooding is self-immersed, problem-focused, and passive (Satyshur et al., 2018).

For the present purposes, we define reflection as a deliberate, analytic, and controlled form of thinking that aims to achieve an epistemic goal, such as a better understanding of the problem at hand. It entails a critical evaluation of one's beliefs and conclusions and, potentially, updating one's belief of what is true and why. Engaging in reflection requires cognitive resources. Reflection is self-distanced in the sense that the focus of attention is on the matter at hand, and not on the self and one's emotions. Brooding, in contrast, consists of unproductive dwelling on one's worries and distressing emotions. The attention is focused on negative self-relevant information without pursuing any clear epistemic goal (Armey et al., 2009; Junkins & Haeffel, 2017). It can be difficult to disengage from brooding: The process can be thought of as a downward-spiral that pulls you deeper and deeper into negative circles of thoughts (Moberly & Watkins, 2008). For a comparison of reflection and brooding, see Table 3.

We argue that, depending on contextual factors, reflection may increase, decrease, or not affect conspiracy beliefs. For brooding, however, a clear prediction can be theoretically derived: it should increase the likelihood of adopting conspiracy beliefs. Our experimental manipulations so far induced rumination in the broader sense, and allowed for a mix of brooding and reflection: Although participants were instructed to write down their worries, and imagine their worry topic to get even worse, they were also asked about causes and consequences of their worry topic in a rather neutral and analytical way. Depending on the context, the reflective aspects of this manipulation may have counteracted the effect of brooding on conspiracy beliefs. This may have contributed to the inconclusive results. We summarize evidence pertaining to the distinct consequences of brooding and reflection below.

Distinct Consequences of Brooding and Reflection

Studies show that brooding and reflection are differentially related to negative affect, as well as negative attention and interpretation biases. Brooding is consistently and positively related to depression and negative affect, even among participants currently not suffering from a psychiatric disease (e.g., Armey et al., 2009; Burwell & Shirk, 2007; Joormann et al., 2006; Watkins, 2009). With regard to reflection, however, it does not seem possible to make as clear a prediction as for brooding. While some studies find no correlation between reflection and depression, others observe that reflection constitutes a protective factor. Yet others observe that reflection, similar to brooding, is positively associated with depression (for a summary, see Allard & Yaroslavsky, 2019). Some have argued that reflection has detrimental consequences only when it is combined with brooding (Junkins & Haeffel, 2017). One reason for this pattern of results may be that the consequences of reflection are highly context dependent: Reflection entails engaging with information about the issue at hand and relating it to one's background knowledge and relevant existing beliefs. As such, reflection combined with different types of background knowledge and pre-existing beliefs would produce different outcomes.

Further, brooding is consistently related to negative attention and interpretation biases, whereas reflection is not. For instance, brooding, but not reflection, is correlated with difficulties to disengage from sad faces, and quick disengagement from happy faces (Allard & Yaroslavsky, 2019; Joormann et al., 2006; Owens & Gibb, 2017). Brooding, but not reflection, is related to impaired executive functions (i.e., slowed refreshing). This suggests that brooders (but not reflectors) attribute greater relevance and allocate more cognitive resources to negative emotional stimuli (Bernblum & Mor, 2010). Further, Lo et al. (2008) observed that brooding was positively, and reflection even negatively associated with a negative cognitive style, defined as making more negative attributions in the Attributional Style Ques-

Table 3. Comparison of Brooding and Reflection

	Brooding	Reflection
Focus of attention	Self-focused; one's negative emotions and worries	Self-distanced; the concrete matter at hand
Processing style	Bias toward negative information; no critical evaluation of one's conclusions; uncontrolled; downward-spiral toward more negative thoughts	Ideally neutral, unbiased; critical evaluation of one's conclusions; deliberate; clear epistemic goal (e.g., understanding, problem-solving…)
Cognitive resources	Requires fewer resources to engage in, but difficult to disengage from	Requires more resources to engage in, but easier to disengage from
Consequences	Negative affect, negative attention and interpretation biases	Context-dependent

tionnaire (a self-report measure that assesses attributions of internality, stability and globality regarding hypothetical events).

These findings suggest that specifically brooding can be expected to increase negative affect and lead to a negatively biased processing of information. Since these are the processes that are relevant for the formation of conspiracy beliefs (see above), we predict that brooding should increase conspiracy beliefs. For reflection, we do not make a clear prediction. Some evidence suggests that reflective forms of thinking (e.g., deliberation) may even counteract conspiracy beliefs directly (Pennycook et al., 2015; Rizeq et al., 2021; Swami et al., 2014), yet this effect may also depend on contextual variables, such as the plausibility of a conspiracy in the respective domain, or the extent to which one is already invested in the idea of a conspiracy (van Prooijen et al., 2020, see Supplement for details on this idea).

Registered Report

This Registered Report conducted a comprehensive test of the hypothesis that brooding about distressing societal issues increases conspiracy beliefs. We also explored how reflection impacts conspiracy beliefs. We experimentally manipulated both brooding and reflection by adapting the experimental procedure from Pilot Study 3: Participants were again dynamically matched with a societal topic that caused them concern. In the brooding condition, participants focused on their worries and negative emotions related to this issue. In the reflection condition, participants were instructed to think about potential explanations for their worry topic in an analytical way. Further, we focused on within-person changes: We included a baseline assessment (T1) 5-10 days prior to the experiment (T2) where participants' conspiracy beliefs about their worry topic were measured. At T2, participants were randomly assigned to three conditions (brooding, reflection, control), went through their respective manipulations, and again indicated their conspiracy beliefs about their worry topic. We predicted that participants in the brooding condition would experience a greater increase (or smaller decrease) in conspiracy beliefs from T1 to T2 than participants in the control group.

By incorporating equivalence and minimum effect tests (for details, see below), we ensured that results are informative and interpretable regardless of whether the hypothesized effect exists or not (Lakens, 2017). Further, we increased the efficiency of our sampling procedure by using a sequential design (Lakens et al., 2021). The last stage of the sequential design had 90% power to detect our smallest effect of interest.

Method

Drafts of the questionnaires for T1 and T2 can be found in the Supplement (English translations) on OSF: https://osf.io/rdpz4/

All materials presented to participants were in German.

Time Point 1 (T1)

Identification of Worry Topic. To begin, participants were presented with six societal issues and asked to rank them according to which worries them most: (a) Growing gap between rich and poor, (b) Growing division in society, (c) Mass surveillance on the internet, (d) Censorship and restriction of freedom of expression, (e) Political influence of large corporations, and (f) Exploitation by global capitalism. Based on a pre-test (see Pilot Study 3 in the Supplement), we selected topics that were worrisome to participants and, at the same time, allowed for the interpretation of a conspiracy. It may be that some topics lend themselves more easily to the interpretation of a conspiracy than others, which could have introduced some bias in between-person comparisons. However, due to randomization, the distribution of selected topics in the conditions should be similar between conditions. All in all, we believe that, for the present purposes, it was more important that all participants received a topic that actually caused them concern, than to keep the actual topic constant across conditions. Nevertheless, we conducted robustness checks to investigate whether effects are similar for different topics, and estimated mixed models that include a random effect for societal topic (exploratory analyses).

Conspiracy Beliefs. Participants indicated the extent to which they believe that their worry topic could be explained by a conspiracy. They answered three items on a 7-point scale, each of which entailed all defining characteristics of

a conspiracy: X exists because powerful actors secretly advance their own interests, even if they harm others in this process; X is caused by influential groups that keep their actions covert and are concerned only with their own advantage; X can be traced back to the fact that certain key players ruthlessly pursue their own goals in secret (X will be replaced by the topic participants chose as most worrisome at T1).

Depression and Suicidality Screening. Participants who did not pass a depression and suicidality screening were not able to complete T2. This is because we did not want to expose vulnerable participants to the brooding manipulation. Participants answered the Patient-Health-Questionnaire-9 (PHQ-9), and a four-item suicide screening tool (Horowitz et al., 2012). Participants who scored 10 or higher on the PHQ-9 (Levis et al., 2019), or answered yes to any of the suicide screening items, were filtered out.

Exploratory Measures. Some measures were included for exploratory purposes, namely participants' trait tendency to brood and reflect (self-developed items), the Conspiracy Mentality Questionnaire (Bruder et al., 2013), the Generic Conspiracist Belief Scale-5 (Kay & Slovic, 2023), and some demographic items (age, gender, level of education, subjective social class, political orientation).

Time Point 2 (T2)

Overall Procedure. First, participants were randomly assigned to brooding, reflection, or control conditions. Then, participants in the brooding and reflection conditions were reminded of the topic they selected at T1 as most worrisome and proceeded to their respective manipulations. Participants in the control condition proceeded directly to the dependent variable. We deliberately chose a control group that proceeds directly to the dependent variable (baseline control group) over a distraction control group because only the baseline control group allows for the conclusion that it was actually brooding that affected conspiracy beliefs. In a distraction control group, it would be impossible to disentangle whether brooding increased, or whether the alternative task given in the distraction control group actually decreased conspiracy beliefs. Nevertheless, this creates a minor limitation: The participants in the brooding and reflection conditions spent extra time answering open-ended, repetitive questions – a task that most participants presumably did not enjoy. As such, the possibility remains that this feature of the manipulation increased frustration, which could, in theory, affect conspiracy beliefs. Yet we believe that the advantages of this design (isolating the causal effect of brooding) outweigh this disadvantage.

After the manipulations, participants answered the dependent variable again (see T1), manipulation checks about the extent to which they brooded, reflected or thought about an unrelated topic during the manipulation (see below), as well the German version of the SPANE (Rahm et al., 2017), which is a short measure of positive and negative affect.

Brooding Manipulation. In the brooding condition, participants were instructed to repeatedly think about the concerns that their worry topic causes them, and how this makes them feel. They answered a series of questions that build onto each other and simulate a downward spiral of worries and negative thoughts. To begin, all participants answered seven questions. Subsequently, all participants answered one cycle of repetitions. Then, the repetition questions were repeated one after the other until five minutes have passed. As soon as five minutes had passed, the "continue" button brought participants to the dependent variable instead of to the next question. Participants received the following instructions: You indicated that X worries you the most. The following is for you to reflect on your concerns about this topic (X will be replaced by the topic participants chose as most worrisome at T1):

1. What concerns do you have about X? Please take a moment to think about this before writing down your concerns.
2. Which of these concerns makes you feel particularly bad?
3. Why does this concern make you feel so bad?
4. How do you feel as you think about this concern? Please describe these feelings in as much detail as possible.
5. Which of these feelings do you find most uncomfortable?
6. Why is this feeling the most uncomfortable for you?
7. What would happen to you if you felt such feelings very intensely for a long time?

Repetitions (until 5 minutes have passed; at least one cycle of repetitions):

1. What other concern about X makes you feel particularly bad?
2. (questions 3-7 as above)

Reflection Manipulation. The goal of the reflection manipulation was for participants to analytically think about the topic and try to achieve an epistemic goal, namely evaluating potential explanations for their worry topic. An important aspect of reflection is that one critically evaluates one's beliefs and interpretations. For this reason, participants generated potential explanations of their worry topic, evaluated the plausibility of these explanations, and thought about alternatives. As in the brooding condition, participants answered seven questions and went through at least one cycle of repetitions. If five minutes had not passed by then, the repetition questions were presented one by one until five minutes were over. They received the following instructions: You indicated that X worries you the most. In the following, you should think about this topic.

1. What could be possible explanation for X? Please take a moment to think about this before writing down the possible explanations.
2. Which of these explanations do you think is the most plausible?
3. What speaks for or against this explanation actually being true?
4. What is a particularly compelling argument **for** this explanation being true?

5. What is a particularly compelling argument **against** this explanation being true?
6. Now that you have thought about this, please make a final judgement: How plausible do you think it is that this explanation is actually true?
7. What could influence your judgement in one direction or the other?

Repetitions (until 5 minutes have passed, at least one cycle of repetitions):

1. What could be another explanation for X that you think is plausible?
2. (questions 3-7 as above)

Manipulation Checks. To ensure that our manipulations achieved what was intended, all participants indicated the extent to which they (a) brooded about their worries and emotions in relation to their worry topic, (b) reflected on potential explanations for their worry topic, and (c) did not think about their worry topic in a particular way *in the five minutes before they answered the dependent variable (DV)*. As such, for participants in the brooding condition, the manipulation checks (MCs) indicated the extent to which they brooded, reflected or thought about something else during the brooding manipulation; in the reflection condition, the MCs captured participants' style of thinking during the reflection manipulation; and in the control condition, the MCs referred to whatever participants did in the 5 minutes before they answered the DV, thus capturing participants' 'thinking as usual'. So, in all conditions, the MCs capture participants' style of thinking in the five minutes before they answered the DV.

Participants read: *When answering the following questions, think about the 5 minutes before you answered the previous page of the questionnaire.* In addition, a timeline will graphically display the 5 minutes participants should refer to (see Supplement for details).

All items were introduced with "During these five minutes…". Brooding was measured with three items: I was constantly thinking depressing thoughts about X, I have been ruminating about unpleasant thoughts and feelings that X triggers in me, and I have thought a lot about how bad my worries about X make me feel. Reflection was measured with three items: I thought analytically about possible explanations for X, I have tried to arrive at the most correct estimate of possible explanations for X, I systematically questioned different explanations for X. 'Thinking as usual' was measured with three items: I did not spend any thought on X, I did not think about X, I have not thought specifically about X.

Analysis Plan

In order to ensure that our final study is informative regardless of whether the hypothesized effect actually exists, we complemented conventional null-hypothesis significance tests with equivalence and minimum effect tests for both the main hypothesis and the manipulation checks (Lakens, 2022; Lakens et al., 2018).

Equivalence tests determine whether effects large enough to be of interest can be rejected. Since it is never possible to demonstrate that an effect is *exactly* zero, performing an equivalence test requires the specification of a range of values that are considered equivalent to zero, that is, a smallest effect size of interest (SESOI): the smallest effect that would still be considered theoretically interesting (Lakens et al., 2018). If the lower and upper limits of the confidence interval of the effect size fall completely within the equivalence range, one would consider the effect equivalent to zero.

Minimum effect tests determine whether effects smaller than the SESOI can be rejected, that is, whether an effect is not just statistically significant, but also practically meaningful. If the confidence interval of the effect size would fall completely beyond the SESOI, one would consider the effect practically meaningful (Lakens, 2017, 2022). All t-tests that will be conducted will be Welch's t-tests.

Justification of Smallest Effect Size of Interest

We begin with defining the SESOI of our main hypothesis test: the effect of brooding on conspiracy beliefs. Subsequently, we outline our rationale for the SESOI of our manipulation checks. To our knowledge, the question of what constitutes a meaningful effect has not yet been addressed in the conspiracy beliefs literature. For this reason, we considered several potential justifications for our SESOI (see Table 4), which are described in detail in the Supplement. This leaves us with five plausible SESOIS that range from d = 0.15 to d ~ .30, with a median of d = 0.20. Based on this median, we suggest d = 0.20 as our SESOI for the effect of brooding on conspiracy beliefs. Since we test a directional hypothesis, we will conduct one-sided equivalence and minimum effect tests. This means that we will consider our effect practically meaningful if the lower limit of the 90% confidence interval of the effect size falls beyond d = 0.20, and practically negligible if the upper limit falls below d = 0.20.

We argue that the SESOI for our manipulation check (i.e., the SESOI that determines whether the manipulation produced a meaningful effect on brooding) should be larger than that of the main hypothesis test: Presumably, a change of a certain magnitude in brooding would lead to a respectively smaller change in conspiracy beliefs. Thus, a larger change in brooding would be required to observe an effect of d = 0.20 on conspiracy beliefs. We are unaware of any recommendations for how the SESOI of a manipulation check should relate to the SESOI of the main effect of interest. Most likely, the manipulation check should show a stronger effect. We propose that the SESOI for the manipulation check should be at least 50% larger, which results in d = 0.30. So, we would consider the effect of the manipulation check practically meaningful if the lower limit of its 90% confidence interval falls beyond d = 0.30, and practically negligible if the upper limit falls below d = 0.30.

Table 4. Set of Plausible Approaches to Setting the SESOI

Approach	Effect size *d*
Small standardized effect (Cohen, 1992)	0.20
Small effect based on empirically derived effect size distributions (Lovakov & Agadullina, 2021)	0.15
Small telescope approach: what the original study had 33% power to detect (Simonsohn, 2015), in this case: Pilot Study 2a	0.18
Meta-analysis of related research (Biddlestone et al., 2022)	0.26
Raw mean difference of within-person changes of .50	~ 0.30

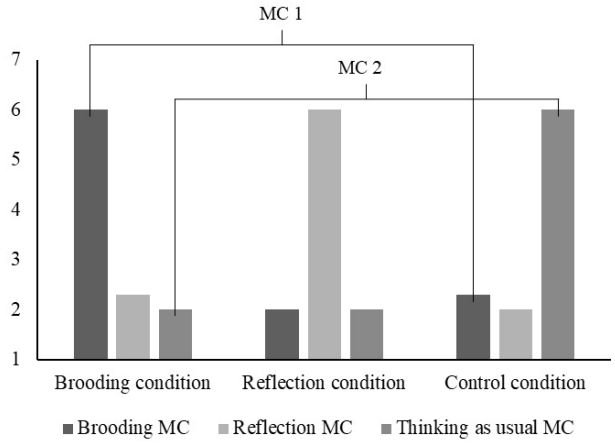

Figure 2. Ideal Pattern of Manipulation Check Results

Note. On the y-axis, mean scores on the brooding, reflection and 'thinking as usual' manipulation checks are depicted. MC1 and MC2 are the key tests on which the testability of our main hypothesis depends.

Manipulation Checks

The following pattern of results would be ideal for our manipulation checks (see also Figure 2): (a) the brooding condition should score meaningfully higher on the brooding MC than both reflection and control conditions, (b) the reflection condition should score meaningfully higher on the reflection MC than both brooding and control conditions, (c) the control group should score meaningfully higher on the 'thinking as usual' MC than both brooding and reflection conditions, (d) reflection and control conditions should not differ on the brooding MC, (e) brooding and control conditions should not differ on the reflection MC, (f) brooding and reflection conditions should not differ on the 'thinking as usual' MC, (g) within the brooding condition, brooding scores should be higher than reflection and 'thinking as usual' scores, (h) within the reflection condition, reflection scores should be higher than brooding and 'thinking as usual' scores, and (i) within the control condition, 'thinking as usual' scores should be higher than brooding and reflection scores.

However, testing each of these hypotheses (which would, ideally, all be supported at the same time) at the usual alpha level would result in a very conservative test of the overall pattern. Further, not all aspects of this pattern are equally important for the analyses we intend to conduct. For this reason, we do not make the entire pattern of results a condition for accepting (or rejecting) our manipulation as effective. Instead, we focus on the most relevant criteria (see also the stopping rules specified in the sampling plan). That is, we will consider the brooding manipulation effective if (1) the brooding condition scores meaningfully higher on the brooding MC than the control group, that is, the lower limit of the 90% CI falls above $d = 0.30$, AND (2) the control group scores meaningfully higher on the 'thinking as usual' MC than the brooding condition, that is, the lower limit of the 90% CI falls above $d = 0.30$ (see also MC 1 and MC 2 in Figure 2). We will nonetheless evaluate the full pattern and discuss how deviations from the optimum might limit the interpretation of the findings.

Should this manipulation check fail, we will nonetheless explore the data and report results for the main hypothesis test. However, we will not draw any confirmatory conclusions about our hypothesis, since it will not be possible to conclude whether it was actually brooding that increased (or failed to increase) conspiracy beliefs (see also Fiedler et al., 2021).

Main Hypothesis Test

To test our main hypothesis, we computed difference scores by subtracting T1 conspiracy belief scores from T2 conspiracy belief scores. We then evaluated whether the brooding condition reported a greater increase (or smaller decrease) in conspiracy beliefs from T1 to T2 than the control group. A one-sided minimum effect test determines whether the effect of the brooding manipulation was practically meaningful (i.e., whether the lower limit of the 90% confidence interval of d falls beyond $d = 0.20$), which would confirm our hypothesis. If not, a one-sided equivalence test determines whether the effect of brooding is practically negligible (i.e., the upper limit of the 90% confidence interval of d falls below $d = 0.20$, equivalence test), which would disconfirm our hypothesis. If neither the equivalence nor the minimum effect test yields a conclusive result (i.e., the 90% CI of d overlaps with $d = 0.20$), a conventional one-sided Welch's t-test determines whether we can at least reject zero. In this case, we would conclude that most likely there is an effect, but it is unclear whether it is practically meaningful.

Exploratory Analyses

Several exploratory analyses were conducted, e.g., concerning negative affect and the role of potential moderators

(e.g., it may be that effects of brooding on conspiracy beliefs are stronger for those participants with a high tendency to brood or with high levels of conspiracy mentality at T1), and whether the within-person change in the reflection condition differs from the within-person change in the control group. We also conducted a variety of robustness checks: e.g., mixed models that include a random effect for which worry topic participants chose, ANCOVA testing for mean differences in T2 conspiracy beliefs using T1 scores as a covariate, bias-corrected effect size estimates instead of Cohen's d (such as Hedge's g and Glass' delta), and Bayes factors that quantify the relative evidence for the null and alternative hypothesis.

Sampling Plan

We aimed to achieve 90% power to detect our smallest SESOI (d = 0.20) with alpha = .05 in a one-sided Welch's t-test. In order to design our study as efficiently as possible, we used a sequential design. This means that data were analyzed repeatedly during data collection and data collection could be stopped, either because sufficient evidence for a meaningful effect had been obtained (the minimum effect test was significant), or because sufficient evidence for the absence of a meaningful effect had been obtained (the equivalence test was significant). Due to the possibility of stopping data collection early, sequential designs lead to a lower average expected sample size than fixed designs, and can thus be considered more efficient (Lakens et al., 2021). In contrast to optional stopping, which is a questionable research practice, the average type I and type II error rates are controlled across looks.

Sequential Design

Using the rpact package (Wassmer & Pahlke, 2022) we have designed a sequential study with 90% power for d = 0.20 in a one-sided test, an alpha level of 5%, and two equally spaced looks (the first look after approximately 50% of data have been collected). The Type I error rate is kept at 5% across both looks using a Pocock-like alpha spending function, and the Type II error rate is kept at 10% using a Pocock-like beta spending function.

An a priori power analysis showed that at most 546 participants per condition were needed (total N = 1,638). The first look was planned after approximately 820 participants had been collected.

Using the Pocock like alpha spending function, we can calculate the alpha levels at each look that would lead to a rejection of the respective null hypotheses of equivalence, minimum effect and conventional t-test. At the first look (50% of data), the alpha level is .031. At the last look (100% of data), the alpha level is .030.

In case of deviations from the pre-planned number or timing of looks, the alpha spending function allows to recalculate the alpha levels based on the exact amount of information that has been observed. So, it is not strictly necessary to analyze the data *exactly* after 50% have been collected (Lakens et al., 2021).

Power for Equivalence and Minimum Effect Test

We planned the design to be able to detect the SESOI of d = 0.20 with 90% power in a one-sided Welch's t-test. We conducted additional sensitivity analyses for the power of the equivalence and minimum effect tests. The power of both of these tests depends on the true effect size, and how close it is to the SESOI: If the true effect size happened to be identical to the SESOI, neither the null hypothesis of the equivalence test (i.e., an effect as large or larger than d = 0.20) nor that of the minimum effect test (i.e., an effect below d = 0.20) could be correctly rejected: every significant result would be a type I error. The closer the true effect is to d = 0.20, the more participants are needed for a high-powered equivalence and minimum effect test.

Assuming a true effect of zero, the one-sided equivalence test at the final stage of the sequential design would have 99% power (with n = 1092 [for two conditions] and alpha = 5%). Assuming a true effect of d = 0.1, the equivalence test would have 75% power. Assuming a true effect of d = 0.35, the minimum effect test at the final stage would have 97% power (with n = 1092 and alpha = 5%). Assuming a true effect size of d = 0.30, the minimum effect test would have 76% power.

Stopping Rules

We would have terminated data collection if any of the following conditions had been met (see also the Design Table in the Supplement): (a) the brooding manipulation was ineffective, that is, the equivalence test for the brooding MC was significant (the upper limit of the 90% CI fell below d = 0.30), OR the equivalence test for the 'thinking as usual' items was significant (the upper limit of the 90% CI falls below d = 0.30); (b) the presence of a meaningful effect of brooding on conspiracy beliefs could be rejected (significant equivalence test: the upper limit of the 90% CI falls below d = 0.20); (c) the manipulation was effective AND the effect of brooding on conspiracy beliefs was practically meaningful (significant minimum effect test: the lower limit of the 90% CI falls above d = 0.20).

Recruitment of Participants

Participants were recruited from the non-commercial SoSci Panel (Leiner, 2016). This panel provides two major advantages compared to other providers: First, its participants have signed up for the panel because they are genuinely interested in participating in surveys, which should increase data quality and compliance (Leiner, 2016). Second, the panel provides a large pool of German-speaking participants: In August 2019, more than 80,000 active panelists were registered in the SoSci Panel, the majority of which is resident in Germany (SoSci Panel, 2023). This clearly outnumbers the pool of German-speaking participants on Prolific.

We planned data collection as follows: In a first step, recruit approximately 1,000 participants for T1. Then, invite these participants to T2 5-10 days later and filter out those who did not pass the depression or suicidality screening, or

did not complete T1 until the end at the beginning of T2. We hoped that, from this first round of invitations, about 820 participants (i.e., about 50% of the full sample) would complete T2 and pass the exclusion criteria, allowing us to perform the first look. Had this not been the case, more participants would have been recruited, until about 820 could be included in T2. In case of an inconclusive result at the first look, we planned to recruit another batch of 800 participants for T1 and to invite them to T2 5-10 days later. Had this strategy not been sufficient to achieve the full sample (N = 1,638), more participants would have been added successively until the full sample size was achieved.

As planned, participants were excluded from data analysis if they (a) cancelled their participation and requested their responses to be deleted, (b) did not provide complete data on all necessary measurements (i.e., the manipulations, dependent variable, and manipulation checks), or (c) if they indicated at the end of the survey that they did not participate seriously. Participants (including those who were filtered out in the depression and suicidality screening) were able to participate in a raffle of 5 vouchers worth 100 €.

Three further participants had to be excluded due to unforeseeable technical errors: one person completed T1 twice (which should not have been technically possible). Two other participants completed T2, then restarted the survey and were randomized again. Data from these participants are uninterpretable, which is why we excluded them from analysis.

Results

All data, analysis scripts, and study materials (German original and English translation), can be found on OSF: https://osf.io/rdpz4/.

Look 1

The first look was conducted with 50% of the required sample size per condition. Specifically, the first look was conducted with the first n = 273 participants, respectively, in the brooding and control condition. Note that, because early termination of the study was more frequent in the brooding condition than in the control condition, the target sample size was achieved earlier in the control condition than in the brooding condition.

Stopping Rules. We checked whether any of the stopping rules for our manipulation checks were applicable. Regarding the brooding MC, the effect size was clearly beyond our SESOI of d = .30: d = 1.38, 90% CI [1.22, 1.53]. Similarly, the effect size of the 'thinking as usual' MC was clearly beyond this SESOI: d = 1.06, 90% CI [0.91, 1.21]. This confirms the success of our manipulations and does not warrant a stop of data collection.

Regarding our main hypothesis test, the 90% CI of the effect of brooding on conspiracy beliefs overlapped with our SESOI of d = 0.20: d = 0.18, 90% CI [0.04, 0.34]. As such, neither the equivalence nor the minimum effect test could provide a conclusive result. For this reason, we continued data collection.

Look 2

Sample. To achieve the desired level of power for our confirmatory test, 546 participants per condition were needed for the final look. To match the planned analysis as closely as possible, we conducted the final look with the first 546 participants, respectively, that completed each condition. This resulted in a sample of N = 1,638, out of which 893 identified as female, 736 as male, and 9 as diverse. The average age was 52.12, (SD = 14.14). The sample was highly educated: 172 completed a PhD, 975 completed a university degree, 251 completed high school ("Abitur"), 209 completed higher secondary school ("Realschule"), and 31 completed lower secondary school ("Hauptschule") as their highest degree of education.

At the time when the brooding condition reached the sample size required for the registered analysis (n = 546), the control condition already contained 703 participants that passed the inclusion criteria, and the reflection condition contained 499. This suggests that early termination of the study was more frequent in the brooding and reflection conditions than in the control condition. We will investigate dropout more closely in the exploratory analyses.

More participants than required for the final look completed the survey. Until October 15, 2023, N = 2,007 completed the study and passed the inclusion criteria. We report results of this full sample in the Supplement (this did not change any conclusions of the registered analyses).

Manipulation Checks. We first tested whether our manipulation worked as intended. Both confirmatory manipulation checks, on which the testability of our main hypothesis depends, were successful: the brooding condition scored meaningfully higher on the brooding MC compared to the control condition: $t(1023) = 17.53$, $p < .001$, d = 1.36, 90% CI [1.25, 1.47]. Similarly, the control condition scored meaningfully higher on the 'thinking as usual' MC compared to the brooding condition: $t(986.7) = 13.12$, $p < .001$, d = 1.09, 90% CI [0.99, 1.20].

Next, we examined how much time people spent with the experimental manipulations: The median time spent with the brooding manipulation was 14.30 minutes. The median time spent with the reflection manipulation was 18.39 minutes. The median number of iterations that participants went through was two for both brooding and reflection manipulations.

Direct comparisons of mean values across brooding and reflection MC scales may be difficult to interpret due to potential differences in item difficulties. Therefore, for an exploratory analysis of the full pattern of manipulation checks, we z-standardized the brooding MC, reflection MC, and 'thinking as usual' scores and plotted them in boxplots for each condition (see Figure 3). Results were largely in line with the idealized pattern of MCs described in the Analysis Plan: The brooding condition scored highest on the brooding MC, the reflection condition scored highest on the reflection MC, and the control condition scored highest on the 'thinking as usual' MC. Also, within the brooding condition, scores on the brooding MC were highest; within the reflection condition, scores on the reflection MC were

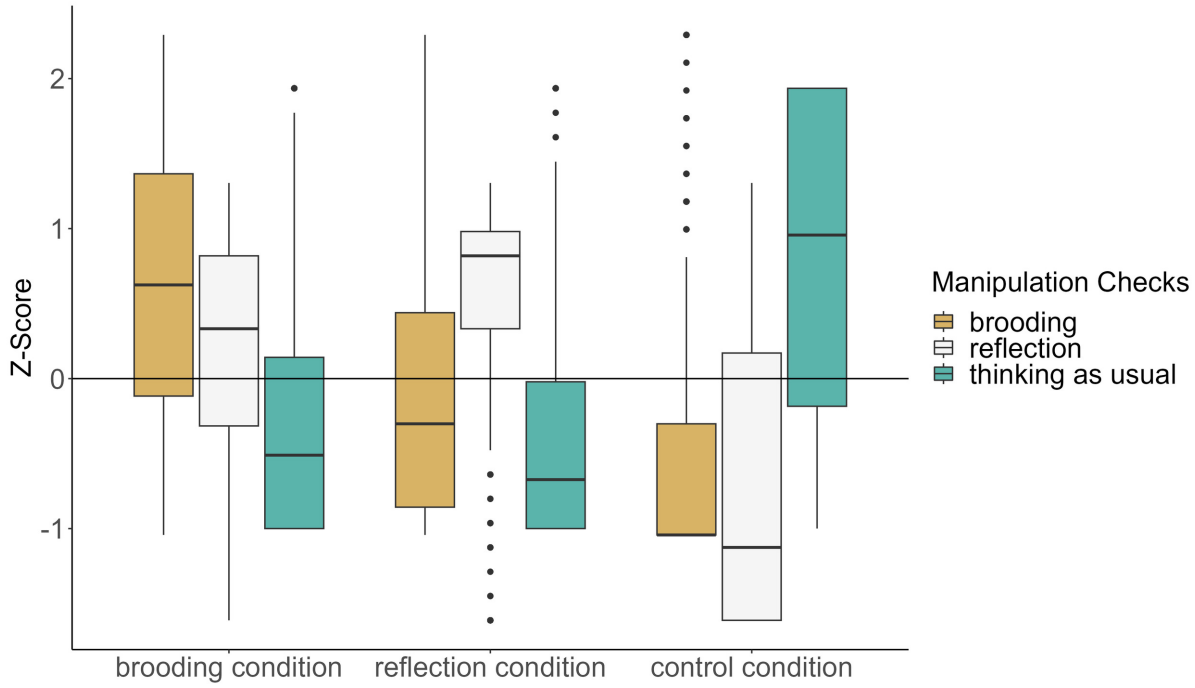

Figure 3. Full Pattern of Manipulation Checks

Table 5. Descriptive Statistics for Conspiracy Beliefs by Condition

	Control condition (*n* = 546)	Brooding condition (*n* = 546)	Reflection condition (*n* = 546)
T1 Conspiracy Beliefs: *M (SD)*	3.93 (1.94)	4.03 (1.92)	3.97 (2.01)
T2 Conspiracy Beliefs: *M (SD)*	3.02 (1.71)	3.39 (1.94)	3.24 (1.91)
T2-T1 Difference Score: *M (SD)*	-0.92 (1.49)	-0.64 (1.34)	-0.73 (1.42)

highest; and within the control condition, 'thinking as usual' scores were highest. However, it is notable that the brooding condition also reported relatively high reflection scores. We will return to this observation in the General Discussion.

Main Hypothesis Test. Our main hypothesis concerns the difference score in conspiracy beliefs between the brooding and control condition. Notably, all conditions reported a decrease in conspiracy beliefs from T1 to T2, resulting in difference scores with a negative sign in all conditions (for descriptive statistics by condition, see Table 5).

A one-sided Welch's t-test comparing difference scores between the brooding and control condition yielded a statistically significant result: $t(1078.8) = -3.19$, $p < .001$, $d = 0.19$, 90% CI [0.09, 0.29]. This demonstrates that brooding resulted in significantly smaller decreases in conspiracy beliefs compared to the control group. However, the confidence interval of this effect overlapped with $d = 0.20$ (see Figure 4), suggesting that neither the minimum effect test ($t(1079) = -0.11$, $p = .545$) nor the equivalence test could yield a significant result ($t(1079) = -0.11$, $p = .455$). Thus, our hypothesis of a meaningful effect could not be confirmed. We can conclude that brooding resulted in higher conspiracy beliefs compared to the control group, but it is unclear whether this effect is practically meaningful regarding our proposed SESOI of d = 0.20.

Exploratory Analyses

We conducted exploratory analyses pertaining to the effect of reflection on conspiracy beliefs, and to the role of positive and negative affect. We further conducted a variety of robustness checks concerning the effect of brooding on conspiracy beliefs, and investigated whether early termination of T2 during the manipulations was predicted by T1 conspiracy beliefs and/or condition. For these analyses, we used the largest sample we had available (i.e., all participants that passed the inclusion criteria and completed the study until October 15, 2023, see section Look 2: Sample). We summarize the results of these analyses here, and present details in the Supplement.

Reflection. We were interested to explore how reflection impacted conspiracy beliefs. Descriptively, the reflection condition reported a smaller decrease in conspiracy beliefs from T1 to T2 than the control condition ($M_{reflection}$ = -0.74, $SD_{reflection}$ = 1.42, $M_{control}$ = -0.94, $SD_{control}$ = 1.49). This mean difference was statistically significant in a two-sided Welch's t-test. We will come back to this finding in the General Discussion.

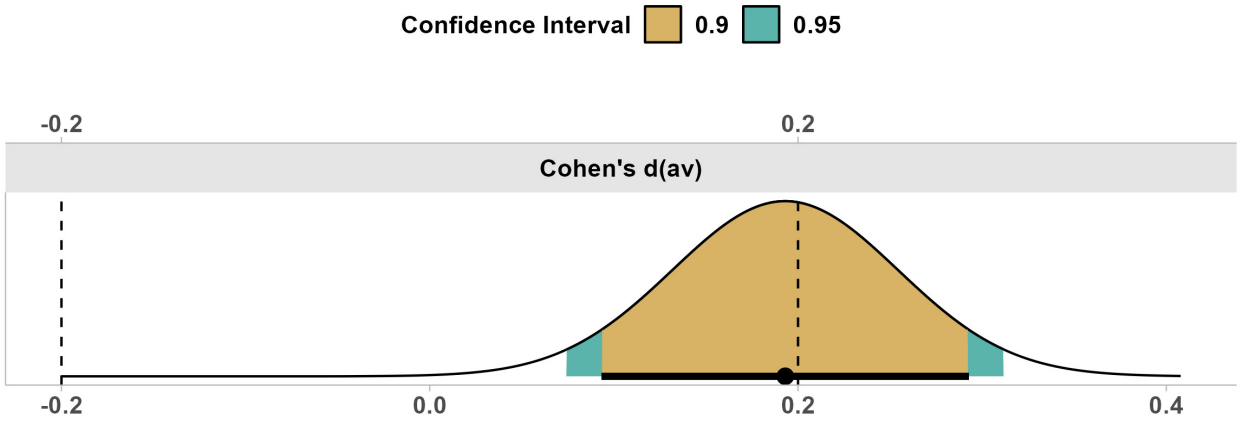

Figure 4. Consonance Density Plot for the Effect of Brooding on Conspiracy Beliefs

Negative and Positive Affect. Brooding and reflection significantly increased negative affect, and significantly decreased positive affect compared to the control group. In addition, brooding induced more negative and less positive affect than reflection. These results are consistent with the idea that brooding increases negative affect.

Robustness Checks. Several analyses confirmed the robustness of the effect of brooding on conspiracy beliefs: between-person analyses testing for mean differences in T2 conspiracy belief scores, a mixed model including a random effect for participants' worry topic, an ANCOVA testing for mean differences in T2 conspiracy beliefs using T1 scores as a covariate, bias-corrected effect size estimates, and Bayes Factors all yielded the same conclusion reported in the main analysis.

Potential Moderators. Participants trait tendency to brood (measured at T1) and their baseline conspiracy beliefs (CMQ and GCBS, both measured at T1) did not significantly moderate the effect of brooding on conspiracy beliefs. However, power for these tests was likely low (Sommet et al., 2023).

Dropout Analyses. We analyzed whether early termination of T2 during the manipulations (i.e., after being randomized to a condition) was predicted by T1 conspiracy beliefs and/or condition. Results revealed that T1 conspiracy beliefs did not predict early termination during T2. However, being in the brooding (vs. control) and reflection (vs. control) condition significantly decreased the likelihood of completing T2. This is consistent with the observation that the target sample sizes for the planned analyses were achieved earlier in the control than in the two experimental conditions.

General Discussion

Several influential psychological models on the formation of conspiracy beliefs would predict that rumination, a repetitive style of thinking about negative content (Nolen-Hoeksema et al., 2008; Watkins & Roberts, 2020), should increase conspiracy beliefs (Douglas et al., 2017; Molenda et al., 2023; van Prooijen & Douglas, 2018). Building on a series of correlational and experimental pilot studies, this Registered Report investigated the causal effect of brooding, a particularly dysfunctional subtype of rumination, on conspiracy beliefs. We predicted that brooding about societal problems increases conspiracy beliefs. Moreover, we explored the effect of reflection, a more analytic form of rumination, on conspiracy beliefs. We did not derive a specific prediction for reflection: we argue that its impact on conspiracy beliefs depends on further, sometimes difficult to assess or quantify factors.

To investigate the effects of brooding and reflection on conspiracy beliefs, we designed a repeated-measures within-person experiment. We tested whether participants in the brooding condition experienced a significantly greater increase (or smaller decrease) in conspiracy beliefs than those in the control group. Results revealed that brooding led to a significantly smaller decrease conspiracy beliefs. That is, participants that brooded over the worries and negative emotions that their topic caused them reported a significantly smaller decrease in conspiracy beliefs from T1 to T2 than those in the control condition. However, it remains unclear whether that effect exceeds the prespecified smallest effect size of interest: The 90% CI of the observed effect size estimate overlapped with our proposed SESOI (d = 0.20). That is, we could neither confirm that the effect is practically meaningful, nor conclude that it is too small to be of interest. Nonetheless, we can conclude that the effect is significantly different from zero. Thus, the result of this experiment is consistent with brooding contributing to conspiracy beliefs.

We further explored how reflection impacted conspiracy beliefs. We did not have a clear prediction for reflection: Depending on further factors (e.g., the plausibility of a conspiracy in the respective domain), arguments could be made that reflection should increase, decrease, or not affect conspiracy beliefs. Results showed that reflection, too, led to a significantly smaller decrease in conspiracy beliefs from T1 to T2 compared to the control group. We discuss potential explanations for this finding below.

Theoretical and Practical Implications

The finding that brooding increased conspiracy beliefs is consistent with current psychological theories on conspiracy beliefs, which emphasize the role of negative affective experiences and cognitive biases (Douglas et al., 2017; Frenken & Imhoff, 2022; Green & Douglas, 2018; van Prooijen & Douglas, 2018). Brooding induces negative affect, which could, in turn, make people more susceptible to conspiracy beliefs (Molenda et al., 2023). However, negative affect might not be the only factor at play here: Brooding narrows the attention to negative information, which facilitates negative attributions and makes negative events appear more likely (Lyubomirsky et al., 1999; Lyubomirsky & Nolen-Hoeksema, 1995). This negatively distorted view of the world could also make conspiracies appear more likely. However, more research is needed to investigate the precise mechanism through which brooding impacts conspiracy beliefs.

The present research also emphasizes the overlap between paranoia and conspiracy beliefs: A worry-thinking-style (which is similar to brooding) has been proposed as a causal factor involved in the development and maintenance of paranoid delusions (Foster et al., 2010; Freeman et al., 2012, 2015). In conjunction with our findings, it appears likely that brooding is a causal factor that conspiracy beliefs and paranoid delusions share. As such, this research adds to the literature that places conspiracy beliefs in the context of mental health. Rumination in general, and brooding in particular, represent a risk factor for many psychological disorders (Aldao et al., 2010), and could explain why conspiracy believers tend to be more vulnerable to a variety of mental health problems (Barron et al., 2018; Chen et al., 2020; Coninck et al., 2021; Furnham & Grover, 2021; Leibovitz et al., 2021). However, this idea is speculative at this point, and should be tested by future research.

Exploratory analyses showed that reflection also resulted in a smaller decrease in conspiracy beliefs compared to the control group. What does this mean? Ultimately, this remains an open question that requires further investigation. Several explanations appear plausible. First, it may be that brooding and reflection impacted conspiracy beliefs independently through different mechanisms. Reflecting about the societal topics may have made participants aware that a conspiracy is not such an implausible explanation after all. When reflecting about a topic where a conspiracy is plausible, then reflection should illuminate that a conspiracy constitutes a suitable explanation. Perhaps the societal topics we used were examples of areas where one could reasonably suspect (elements of) a conspiracy (e.g., certain interest groups working secretly to further enable the exploitation of poor countries). Brooding, in contrast, might have increased conspiracy beliefs through a less deliberate and more emotional process, i.e., by inducing negative affect and narrowing the attention on negative content.

It is also possible that brooding and reflection increased conspiracy beliefs through similar mechanisms: Perhaps merely thinking about the societal topics we used in a repetitive manner is sufficient for increasing conspiracy beliefs about them. Participants in both the brooding and reflection condition engaged repetitively with a topic that caused them concern. So, despite their differences, both manipulations can be considered examples of repetitive negative thinking (Ehring & Watkins, 2008), which may be the driving force behind the effects. However, since results for reflection were based on exploratory analyses, we refrain from drawing confirmatory conclusions about this effect and call for further research on the topic.

The finding that brooding increased conspiracy beliefs implies that interventions aimed at reducing conspiracy beliefs might profit from targeting brooding as a potential cause and facilitator. For this purpose, inspiration can be found in cognitive-behavioral techniques like psychoeducation, identification of meta-beliefs about worrying, awareness of initiation and triggers, as well es learning to 'let go' of worries (Freeman et al., 2015). Given our results, it would be premature to assume that such interventions would lead to meaningful changes in conspiracy beliefs. If effective, such interventions would have the advantage that they do not have to address the content of conspiracy beliefs directly and may avoid backfire effects that are sometimes associated with misinformation correction (Lewandowsky et al., 2012).

Further, politicians, journalists, and other public communicators should be aware that framing news topics in a manner that facilitates brooding may promote the formation of conspiracy beliefs. News reports, especially on social media, are often geared toward eliciting shock, outrage, and other negative emotions (Brady et al., 2017; Crockett, 2017). Exposure to such news presumably increases the likelihood of dysfunctional brooding about societal events. A more neutral presentation of news topics could prevent the adoption of unfounded conspiracy beliefs among the public. This is not to say that the media should avoid presenting facts that speak for real conspiracies – when these facts are well-grounded in evidence, the public should be informed about and encouraged to believe in them.

Practical Meaningfulness and Generalizability

With this Registered Report, we hope to initiate a discussion about smallest effect sizes of interest in the domain of conspiracy beliefs. We settled on a SESOI of $d = 0.20$ as a median of several somewhat justifiable candidate values. However, in our opinion this SESOI should be treated as preliminary. So far, it remains unknown how large an effect on conspiracy beliefs in a controlled experiment must be to make a meaningful difference in the real world. To further complicate things, even in the real world different SESOIs could be set depending on what criterion is used to judge the meaningfulness of an effect: subjective experience, prevalence of unsubstantiated conspiracy beliefs in target populations, or relevant behaviors all come to mind. A useful next step in this endeavor could be to determine the smallest change in an outcome of interest that participants still rate as actually different (Anvari & Lakens, 2021). A similar approach can be found in clinical research under the name of 'minimal clinically important differ-

ence'. In contrast, this approach does not rely on global ratings of change provided by the participants themselves, but rather on evaluations of expert observers (Anvari & Lakens, 2021).

In addition, standardized effect sizes are not inherently meaningful without further context. Funder & Ozer (2019) argue that effect sizes should not simply be labeled as small, medium, or large without specifying the implied comparison (i.e., small or large compared to what?). In our case, the observed effect of $d = 0.18$ would traditionally be considered a small effect (Cohen, 1992). It would also be considered a small effect compared to the average effect sizes published in social and personality psychology (Gignac & Szodorai, 2016; Lovakov & Agadullina, 2017). However, a small effect that appears reliably in an experimental setting can be expected to accumulate over time in people's real lives (Funder & Ozer, 2019). Importantly, our experiment induced brooding only once, and measured the effect of that single instance on conspiracy beliefs. If every time a person broods over a certain problem in their daily lives the degree of belief in a conspiracy increases by a small amount, then this can accumulate over time and situations to a consequential effect (Funder & Ozer, 2019). So, our findings should ideally be complemented with longitudinal studies. In these, brooding and conspiracy beliefs could be measured repeatedly and with multiple time-lags to better understand the temporal characteristics of the effect. It is, for example, conceivable that brooding only has a fleeting effect on conspiracy beliefs. It is, however, also conceivable that the effects of brooding on conspiracy beliefs accumulate over time.

For ethical considerations, we excluded participants who did not pass a depression and/or suicidality screening test. Although we still consider this the preferable approach, it does introduce a potential confounding factor. It is possible that participants dealing with concurrent depression or suicidality might have found it easier to engage with the brooding manipulation, potentially amplifying the of brooding on conspiracy beliefs if they had been included. Conversely, it is also possible that the brooding manipulation might not have significantly affected those who were already experiencing depression, diminishing the effect of brooding if they had been included. To address this potential confounding, future non-experimental research (using, for example, longitudinal designs) is required.

Importantly, the results reported here depend on the specific societal topics that were used to induce brooding and reflection. This is an unavoidable feature of our study design. It is possible that brooding or reflection about other topics might have yielded different results. Future research should examine whether the effects we observed depend on specific characteristics of the topics that one broods or reflects about. Of course, not only the selection of topics may result in limited generalizability, but also the specifics of the experimental paradigm as a whole (e.g., Bless & Burger, 2016). Lastly, the current research was conducted in Germany with a highly educated sample. To better understand the generalizability of the results, it would be important to consider how cultural differences and sample characteristics (e.g., level of education) might influence the effect of brooding on conspiracy beliefs.

Limitations and Directions for Future Research

The repeated-measures design used here might have made it easier for participants to guess what the study is about, introducing the possibility of biases due to demand- or reactance-effects. This could be a potential explanation for why conspiracy beliefs, on average, decreased between measurements: At T2, participants might have suspected what the study was about and corrected their responses downward (to not feel like they were influenced into reporting higher conspiracy beliefs).

The decrease in conspiracy beliefs from T1 to T2 might also be attributed to the way they were measured at both time points. During T1, participants were asked to choose the societal issue that concerned them the most from a list of six topics. Being confronted with numerous social issues might have in itself contributed to higher scores on the conspiracy belief measure. Perhaps, the plurality of social problems has been interpreted as evidence for a conspiracy or being confronted with multiple worry topics resulted in spontaneous brooding.

A further limitation concerns the fact that both brooding and reflection manipulations consisted of rather long, demanding open-text questions that most participants presumably did not enjoy. It is conceivable that this induction of irritation and/or frustration could have influenced conspiracy beliefs. Future research should complement our study design with an additional control condition engaging in equally unpleasant but unrelated tasks.

The fact that the brooding and reflection conditions were longer and more demanding than the empty control group could explain why early termination of the study at T2 was more frequent in the brooding and reflection conditions than in the control group. Potentially, this selective dropout could introduce some bias (e.g., if people in the brooding condition who would have displayed lower changes in conspiracy beliefs from T1 to T2 were also more likely to drop out). By including an active control group, it would be possible to test the robustness of the effect observed in the present study.

The relation between brooding and reflection is a topic of ongoing debate (Bartoskova et al., 2018; Junkins & Haeffel, 2017). Interestingly, we observed that our brooding manipulation also led to higher self-reported reflection compared to the control condition. On the one hand, this may be due to differences in item difficulties, resulting, for example, from social desirability or self-serving biases that render it more appealing to score high on reflection. On the other hand, this finding may indicate that brooding and reflection co-occur with one another, at least in participants subjective perceptions. Research on meta-beliefs about worrying demonstrate that people tend to believe that worrying is useful (Borkovec et al., 1999). For example, people believe that worrying helps them prepare for the future or prevent bad things from happening to them. Such meta-beliefs about the functional nature of worrying might lead to brooding being genuinely experienced as a sort of

reflection. Further, it seems very unlikely that our experimental manipulations resulted in "pure" forms of brooding and reflection. Some overlap is presumably unavoidable.

Relatedly, it has been argued that, in real life, people do not simply fall into one of two categories of "brooders" or "reflectors". Instead, most people report matching levels of brooding and reflection, that is, they tend to score low, medium, or high on both reflection and brooding (Junkins & Haeffel, 2017). Future research should examine the extent to which brooding and reflection can be considered independent processes.

Psychological theories and research on conspiracy beliefs may profit from a higher level of formalization that allows for the derivation of precise predictions (see, e.g., Oberauer & Lewandowsky, 2019). For example, especially in the context of our reflection manipulation, we encouraged participants to reason about potential explanations for their worry topics, with conspiracies being one of the many types of candidate explanations. Specifically, participants were asked to reason about potential causes, weight evidence, and evaluate the plausibility of several more or less likely explanations. In this regard, we see great potential for synergies between the literature on conspiracy beliefs and work from cognitive psychology on causality, reasoning under uncertainty, and explanations (e.g., Douven & Mirabile, 2018; Gerstenberg, 2022; Over & Cruz, 2018; Sebben & Ullrich, 2021). This work may prove useful to, for example, better understand and formalize the effects of reflection on conspiracy beliefs and the boundary conditions of these effects.

Lastly, the preregistered experiment focused on the effect of brooding on conspiracy beliefs. Future research should also consider the possibility of an effect in the reversed causal direction: Conspiracy beliefs might lead to increased levels of brooding. Conspiracy beliefs are inherently negative in content and provide a lot of additional content that one can brood about. Relatedly, longitudinal research has found initial evidence that conspiracy beliefs are under some circumstances followed by increases in uncertainty- and fear-related states: In one out of two studies, increases in conspiracy beliefs predicted increases in anxiety, uncertainty aversion, and existential threat (Liekefett et al., 2021). Another study using two measurements found that COVID-19 conspiracy beliefs predicted higher levels of anxiety one month later (Leibovitz et al., 2021). Apparently, conspiracy beliefs may hold the potential to reinforce negative cognitive-affective experiences – a finding that could extend to brooding.

Conclusion

This Registered Report investigated the role of two subtypes of rumination in the formation of conspiracy beliefs: brooding and reflection. Results of a repeated-measures within-person experiment revealed that participants who brooded over a societal topic that caused them concern reported a significantly smaller decrease in conspiracy beliefs from T1 to T2 than participants in the control group. This finding supports the idea that brooding enables or causes conspiracy beliefs. However, a combination of minimum effect and equivalence tests could neither confirm nor reject the hypothesis that this effect exceeds our proposed smallest effect size of interest (d = 0.20). We call for further research and discussion about meaningful smallest effect sizes of interest in the conspiracy belief literature.

Author Contributions

Contributed to conception and design: LL, SS, JCB
Contributed to acquisition of data: LL, SS, JCB
Contributed to analysis and interpretation of data: LL, SS
Drafted and/or revised the article: LL, SS, JCB
Approved the submitted version for publication: LL, SS, JCB

Competing Interests

There are no competing interests to declare.

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Data Accessibility

All materials, participant data, and analysis scripts can be found on the OSF: https://osf.io/rdpz4/

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Supplementary Materials

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