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To cite this article: Natasha Parikh, Kevin S. LaBar & Felipe De Brigard (2020) Phenomenology of counterfactual thinking is dampened in anxious individuals, *Cognition and Emotion*, 34:8, 1737-1745, DOI: [10.1080/02699931.2020.1802230](https://doi.org/10.1080/02699931.2020.1802230)

To link to this article: <https://doi.org/10.1080/02699931.2020.1802230>

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BRIEF ARTICLE



## Phenomenology of counterfactual thinking is dampened in anxious individuals

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### ABSTRACT

Counterfactual thinking (CFT), or simulating alternative versions of occurred events, is a common psychological strategy people use to process events in their lives. However, CFT is also a core component of ruminative thinking that contributes to psychopathology. Though prior studies have tried to distinguish adaptive from maladaptive CFT, our study provides a novel demonstration that identifies phenomenological differences across CFT in participants with varying levels of trait anxiety. Participants ( $N = 96$ ) identified negative, regretful memories from the past 5 years and created a better counterfactual alternative (upward CFT), a worse counterfactual alternative (downward CFT), or simply recalled each memory. Participants with high levels of trait anxiety used more negative language when describing their mental simulations, reported lower ratings of composition during upward CFT, and reported more difficulty in imagining the emotion they would have felt had negative events turned out to be better. Additionally, participants with high anxiety thought that upward CFT was less likely to occur relative to individuals with low anxiety. These results help to clarify how mental simulations of aversive life events are altered in anxiety and serve as a stepping stone to future research uncovering the mechanisms of ruminative thought patterns.

### ARTICLE HISTORY

Received 30 October 2019  
Revised 10 July 2020  
Accepted 15 July 2020

### KEYWORDS

Counterfactual thinking;  
autobiographical memory;  
phenomenology; rumination;  
anxiety

We frequently imagine how past events could have been different. These “counterfactual thoughts” are often generated to help people learn from past experiences. Counterfactual thinking (CFT) is often adaptive: it reinforces beneficial behaviour, provides potential solutions for past errors (Roese & Epstude, 2017), and provides rational roadmaps for future preparation (Byrne, 2016). Thinking about how an event could have been worse (*downward CFT*) often produces relief, which helps alleviate negative emotions that may hinder future performance. Imagining how an event could have been better (*upward CFT*) can provide strategies for the future. Moreover, repeatedly simulating a counterfactual thought decreases its perceived plausibility (Stanley et al., 2017), helping people accept their present situation (De Brigard et al., 2013).

However, CFT does not always lead to positive outcomes, as is evident in excessive rumination and worry (Brinker & Dozois, 2009; Nolen-Hoeksema, 2000; Tanner et al., 2013). After a traumatic event, people who create more counterfactual thoughts report higher stress post-trauma, and individuals with higher anxiety or post-traumatic stress disorder (PTSD) symptomatology generate more CFT than controls (Callander et al., 2007; Davis et al., 1995; Gilbar et al., 2010).

Why does CFT help some people but hinder others? One explanation is that counterfactual thoughts are phenomenally different for those with maladaptive CFT (Brown et al., 2014; Morgan, 2010; Moustafa et al., 2019). For example, people with depression and PTSD overgeneralise memories (Morgan, 2010; Wessel et al.,

2001). Rumination skews memories and future thoughts toward negativity, reduced specificity, and increased sense of reliving (Finnbogadóttir & Thomsen, 2013; Thomsen et al., 2011). Given well-established evidence documenting commonalities in the neural and cognitive mechanisms underlying CFT, episodic memory, and future thinking (Benoit & Schacter, 2015), these findings support the idea that there may also be fundamental differences between adaptive and maladaptive CFT. Furthermore, recent evidence finds a strong association between post-trauma CFT vivacity and frequency and increased post traumatic symptomatology (Blix et al., 2016, 2018).

Understanding phenomenological differences in adaptive versus maladaptive CFT is important both to characterize individual differences and to develop better targeted interventions. Yet, individual differences across CFT experience in populations more likely to create maladaptive counterfactuals have not been well studied. To fill this gap, this study examines differences in detail and phenomenology during CFT and memory recollection among people with varying levels of trait anxiety. Based on previous research, we expect that memories and CFT will be more negative for participants with higher levels of anxiety. Memories and CFT should also be more general in participants with higher levels of anxiety (and more specific in participants with lower levels of anxiety). Finally, we expect to replicate findings showing that, across participants, CFT will be rated as less detailed and vivid relative to remembering (De Brigard & Giovanello, 2012; Johnson et al., 1988). As a manipulation check, we expect upward CFT to be rated as more positive compared to downward CFT, while simple recall should fall in the middle.

## Methods

### Participants

One-hundred individuals participated online through Amazon's Mechanical Turk (MTurk; Buhrmester et al., 2011). Sample size was based on previous work examining CFT phenomenology across age (De Brigard et al., 2016). Because that study involved between-groups differences (young vs. old) whereas ours uses a continuous predictor (anxiety), we increased our estimate by 50% ( $N = 90$ ). Participants were required to be in the United States, have a Human Intelligence Task (HIT) approval rating of over 85%, and have over 50 HITs already approved. All participants completed

informed consent approved by the Duke University Campus Institutional Review Board. Four participants were excluded from analysis due to repeated, non-sense, or copy-pasted responses, leaving 96 participants ( $M_{age} = 34.4 \pm 10.8$  years, 39 female/57 male, 69 White, 9 Asian, 7 Black/African American, 4 Hispanic/Latino, 2 American Indian/Alaska Native, 1 Native Hawaiian/Pacific Islander, 4 mixed race) for analysis.

### Procedure

After consent, participants completed a trait anxiety questionnaire (STAI-Y2; Spielberger et al., 1983), consisting of 20 questions assessing general trait anxiety levels on a Likert scale (e.g. "I lack self-confidence," scored from 1-Almost never to 4-Almost always). Participants answered four comprehension questions about the task (e.g. "Which of these events is acceptable to use for this experiment?") before providing 6 regretful autobiographical memories that occurred within the past 5 years. Participants were asked to retrieve memories that were regretful because of immediate (as opposed to long-term) negative consequences, and were given an example of such a memory (i.e. "Leaving your raincoat home and getting soaked in the rain"). Memories were restricted to those with immediate consequences so that participants would simulate a single counterfactual thought, rather than one for the initial event and a different one for the outcome. For each memory, participants were asked to rate its emotional valence (1-extremely unhappy to 7-extremely happy); the level of detail of the recollection (1-extremely vague to 7-extremely clear); their regret about the event (1-minimal regret to 7-extreme regret); how much control they felt they had over the situation (1-no control to 7-full control); and how frequently they recalled the event (1-less than once a year to 7-daily).

Immediately after all six memories were collected, participants saw them again in one of three conditions: *upward counterfactual*, *downward counterfactual*, or *remember*. Two memories were randomly assigned to each of the three conditions, and memories were presented in a randomised order. In the *upward counterfactual* condition, participants were asked to think about a way in which the event could have gone better. In the *downward counterfactual* condition, participants were asked to think of how the event could have gone worse. In the *remember* condition, participants were simply told to recall the memory. For each condition, participants were asked

to describe their simulation (in writing) in as much detail as possible for at least 30 s. This time restriction was imposed to encourage participants to recollect/create rich simulations prior to completing their phenomenological ratings (Nook et al., 2017). They were then presented with an adapted version of the Memory Characteristics Questionnaire (MCQ; De Brigard & Giovanello, 2012; Johnson et al., 1988; see Appendix) to assess the phenomenology of memory and counterfactual simulations. Participants took  $\sim 33.1 \pm 26.0$  min to complete the study and were compensated \$5.50 for their time.

### Data processing

Text descriptions obtained during the mental simulation window were coded by the Linguistic Inquiry and Word Count programme (LIWC; Pennebaker et al., 2015), using the 2007 internal and LCM dictionaries, as well as TreeTagger (Schmid, 1994). LIWC and TreeTagger process text data for a variety of linguistic properties by counting words that fall within a list of categories, including pure syntactic categories and categories that have been shown to associate with psychological processes. Because of our interest in level of detail as well as adaptive and maladaptive counterfactual usage, we focused on three measures that correlate with emotion regulation ability (Nook et al., 2017) – negative affect words (e.g. hurt, ugly), positive affect words (e.g. love, nice), and a composite measure of psychological distance – and a measure of linguistic abstraction (Seih et al., 2017). The psychological distance measure was computed by z-scoring and combining measures of first-person singular pronouns (e.g. I, me), present tense verbs, articles (e.g. a, the), discrepancy words (e.g. should, would), and words of more than six letters. The contribution of first-person pronouns, present-tense verbs, and discrepancy words were reversed by multiplying the z-scored scores by  $-1$ . Thus, low psychological distance scores indicate writing that is personal and focused on the present, whereas high scores indicate writing that is impersonal and abstract. The linguistic abstraction measure comes from the Linguistic Category Model (Seih et al., 2017), which combines words from five categories – descriptive action verbs, interpretive action verbs, state verbs, adjectives, and nouns – to create a measure of abstractness, computed by comparing proportions of words that fall into each category (see Seih et al., 2017). A higher abstractness score indicates a higher level of

abstraction, or higher proportions of nouns and adjectives compared to action verbs.

Consistent with previous studies using the MCQ (De Brigard & Giovanello, 2012; D'Argembeau et al., 2003), phenomenology ratings were combined into four factors. Ratings of clarity, colour, visual detail, sound, smell, touch, taste, and vividness were averaged into a single *sensory* factor (Cronbach's  $\alpha = .85$ ). Ratings of composition, location, location of objects, location of people, and clarity of time of day were averaged into a *composition* factor ( $\alpha = .88$ ). Emotional valence during the event and emotional valence now were averaged into an *emotional valence* factor ( $\alpha = .72$ ). Intensity of the emotion during the event, intensity as the participant thought about it now, and general sense of imagining were averaged into an *emotional intensity* factor ( $\alpha = .72$ ). Sense of imagined feeling, event likelihood, and perspective during imagination were analysed as independent measures.

### Analyses

Each individual memory was treated as a separate data point in linear mixed-effects models (LMEMs), where we observed effects of condition and anxiety on each outcome variable. The intercept and subject were treated as fixed factors. Separate models were run for each of the 4 linguistic measures (negative emotion, positive emotion, psychological distance, linguistic abstraction) and the 7 phenomenology measures (sensory, composition, emotional valence, emotional intensity, imagined feeling, event likelihood, and perspective). When significant main effects were found, differences between conditions were assessed with pairwise t-tests using Tukey contrasts and Holm's method for multiple comparisons correction. All statistics were conducted in R (R Core Team, 2017). Means and standard deviations per measure are included in Table S1.

### Results

Participants' simulation descriptions varied in length ( $M_{\text{words}} = 40.18 \pm 30.83$ ,  $\text{Range}_{\text{words}} = 4\text{--}307$ ). Participants' anxiety scores covered the full range of the trait anxiety measure (scores from 20–80), and the data were positively skewed ( $\text{Median} = 38$ ,  $M = 41.91$ ). These scores match values obtained through general health surveys of the American populace (Knight et al., 1983). Based on initial ratings,

participants' anxiety level correlated negatively with their memories' initial reported detail ( $r = -.25$ ,  $p = .014$ ) and positively with frequency of remembering ( $r = .20$ ,  $p = .046$ ). Specifically, people with higher anxiety reported their memories were less detailed and more frequently rehearsed than people with lower anxiety levels. Therefore, these ratings were included in all further analyses as covariates. No correlations were found between anxiety and initial valence, controllability, or regret ratings.<sup>1</sup>

**Text analyses.** The LMEM for negative emotional words revealed main effects of condition,  $b = 2.72$ ,  $SE = 1.11$ ,  $t(479.28) = 2.46$ ,  $p = .014$ , 95% CI [0.55, 4.90], and anxiety,  $b = 0.05$ ,  $SE = 0.02$ ,  $t(401.67) = 2.78$ ,  $p = .006$ , 95% CI [0.02, 0.09]. Pairwise tests revealed that downward counterfactuals were described with greater negative emotional terms than recalled memories,  $b = 2.72$ ,  $SE = 1.11$ ,  $z = 2.46$ ,  $p = .028$ , and upward counterfactuals,  $b = 2.93$ ,  $SE = 1.11$ ,  $z = 2.65$ ,  $p = .025$ . Anxiety was positively correlated with negative word usage; participants with higher trait anxiety used more negative words in their descriptions, regardless of condition (Figure 1(a)). The LMEM for positive emotional words in text descriptions revealed an interaction between condition and anxiety, such that people with higher anxiety used more positive emotional words during upward counterfactual simulation than memory recollection,  $b = 0.04$ ,  $SE = 0.02$ ,  $t(480.03) = 1.99$ ,  $p = .047$ , 95% CI [0.00, 0.07], (Figure 1(b)). The analysis of psychological distance yielded no significant results. Finally, the LMEM for linguistic abstractness revealed a significant main effect of frequency and condition. More frequently remembered memories were simulated more abstractly,  $b = 0.02$ ,  $SE = 0.01$ ,  $t(571.7) = 2.14$ ,  $p = .033$ , 95% CI [0.00, 0.04], and memories were more abstract than upward

counterfactuals,  $b = 0.02$ ,  $SE = 0.09$ ,  $t(479.7) = 2.60$ ,  $p = .010$ , 95% CI [0.06, 0.43].

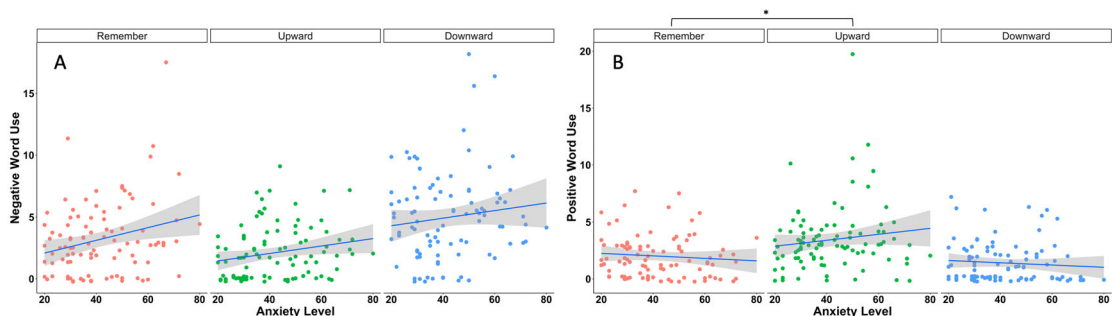
### Phenomenological analyses

For the *sensory* factor, the LMEM revealed that memories simulated as downward counterfactuals have lower sensory details than remembered ones,  $b = -0.55$ ,  $SE = 0.26$ ,  $t(476.5) = -2.14$ ,  $p = .033$ , 95% CI [-1.06, -0.08].

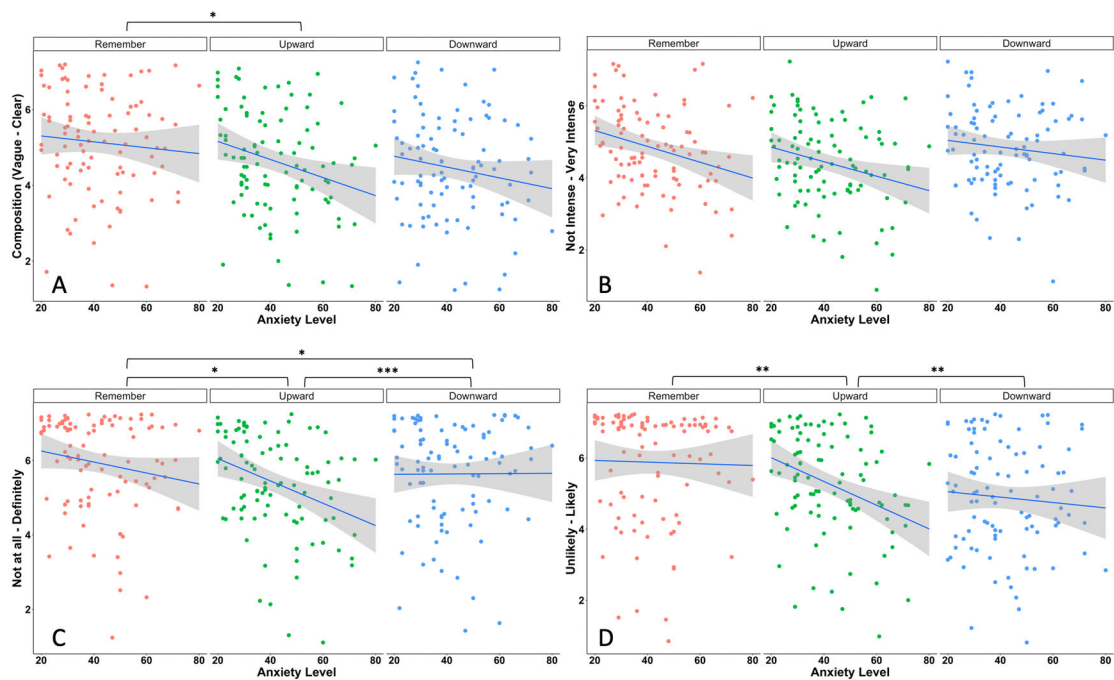
The LMEM on the *composition* factor revealed a significant main effect of initial detail rating,  $b = 0.16$ ,  $SE = 0.05$ ,  $t(575.84) = 3.43$ ,  $p < .001$ , 95% CI [0.07, 0.26], where memories with higher initial detail were simulated with more composition details than those with lower initial detail. There was also a significant interaction between anxiety level and condition; people with higher anxiety reported less composition details during upward counterfactual than remembering,  $b = -0.02$ ,  $SE = 0.01$ ,  $t(476.89) = -2.18$ ,  $p = .030$ , 95% CI [-0.03, 0.00] (Figure 2(a)).

The LMEM for *emotional valence* revealed a main effect of memory condition and initial frequency rating. Participants felt more positively while thinking of upward versus downward counterfactuals  $b = 1.97$ ,  $SE = 0.36$ ,  $t(479.21) = 5.51$ ,  $p < .001$ , 95% CI [1.29, 2.72], or when remembering,  $b = 2.06$ ,  $SE = 0.36$ ,  $t(478.81) = 5.79$ ,  $p < .001$ , 95% CI [1.36, 2.76]. Memories that were remembered more frequently were rated less positively than those remembered less frequently,  $b = -0.09$ ,  $SE = 0.04$ ,  $t(524.13) = -2.65$ ,  $p = .008$ , 95% CI [-0.16, -0.03].

The LMEM for the *emotional intensity* factor revealed significant main effects of initial detail rating, initial frequency rating, and anxiety. More detailed memories were reported to have more



**Figure 1.** Plots depicting results from the text analyses. Subplots show differential results per simulation condition, and each point represents the average value per participant. (a) Number of negative words used in simulation descriptions by participant anxiety level. (b) Number of positive words used in simulation descriptions across participant anxiety level. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .



**Figure 2.** Plots depicting key results from the phenomenology ratings analyses. Subplots show differential results per simulation condition, and each point represents the average value per participant. (a) Ratings for questions relating to composition by anxiety level. (b) Ratings for questions relating to intensity of the event across anxiety level. (c) Ratings of how well can you imagine the event. (d) Correlations between anxiety level and ratings of perceived likelihood. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

intense simulations,  $b = 0.20$ ,  $SE = 0.04$ ,  $t(575.92) = 5.12$ ,  $p < .001$ , 95% CI [0.12, 0.27], and memories thought of more frequently resulted in more intense simulations,  $b = 0.15$ ,  $SE = 0.03$ ,  $t(576.00) = 5.19$ ,  $p < .001$ , 95% CI [0.09, 0.21]. Furthermore, people with higher levels of anxiety rated their simulations as less intense than people with lower levels of anxiety,  $b = -0.02$ ,  $SE = 0.01$ ,  $t(170.04) = -2.99$ ,  $p = .003$ , 95% CI [-0.03, -0.01] (Figure 2(b)).

The LMEM for how well participants could imagine how they might have felt during the event revealed a main effect of condition and of initial detail rating. The emotion for downward counterfactuals was more difficult to imagine than that for recalled memories,  $b = -0.90$ ,  $SE = 0.30$ ,  $t(474.73) = -3.02$ ,  $p = .003$ , 95% CI [-1.49, -0.30] and upward counterfactuals,  $b = -0.98$ ,  $SE = 0.30$ ,  $t(474.86) = -3.28$ ,  $p = .001$ , 95% CI [-1.55, -0.38]. Additionally, the feelings of memories initially rated as very detailed were easier to imagine than low detail memories,  $b = 0.17$ ,  $SE = 0.04$ ,  $t(570.34) = 3.96$ ,  $p < .001$ , 95% CI [0.08, 0.25]. There was also a significant interaction between condition and anxiety, where people with higher anxiety rated emotions during upward counterfactuals as harder

to imagine than remembering,  $b = -0.02$ ,  $SE = 0.01$ ,  $t(474.6) = -2.31$ ,  $p = .021$ , 95% CI [-0.03, 0.00] and downward counterfactuals,  $b = -0.03$ ,  $SE = 0.01$ ,  $t(474.58) = -4.53$ ,  $p < .001$ , 95% CI [-0.04, -0.02], and downward counterfactuals were rated as significantly easier to imagine emotionally compared to remembering for people with higher anxiety,  $b = 0.01$ ,  $SE = 0.01$ ,  $t(474.63) = 2.22$ ,  $p = .027$ , 95% CI [0.00, 0.03] (Figure 2(c)).

There was a main effect of memory condition for event likelihood, where upward counterfactuals were rated as more likely than downward counterfactuals,  $b = 1.46$ ,  $SE = 0.42$ ,  $t(474.57) = 3.44$ ,  $p < .001$ , 95% CI [0.65, 2.23]. There was also a memory condition by anxiety level interaction, driven by a negative relationship between anxiety level and likelihood in upward counterfactuals relative to remembering,  $b = -0.03$ ,  $SE = 0.01$ ,  $t(474.2) = -3.25$ ,  $p = .001$ , 95% CI [-0.05, -0.01] and downward counterfactuals,  $b = -0.03$ ,  $SE = 0.01$ ,  $t(474.15) = -2.71$ ,  $p = .007$ , 95% CI [-0.04, -0.01] (Figure 2(d)).

Lastly, we compared participants' point of view (field, observer, or other) when simulating memories and counterfactuals. Since only 3 memories were



simulated from an “other” perspective, this category was dropped from the analysis. We were then able to conduct a binomial LMEM using Adaptive Gauss-Hermite Quadrature with 10 integration points. This analysis revealed a main effect of initial memory detail on perspective ratings,  $b = -0.44$ ,  $SE = 0.18$ ,  $z = -2.44$ ,  $p = .015$ , 95% CI  $[-0.79, -0.09]$ , such that rating a memory as having higher detail during memory collection made it less likely for participants to simulate it from the third person, regardless of simulation type.

## Discussion

This study sought to identify phenomenological differences across upward and downward CFT and episodic recollection as a function of anxiety level. We examined systematic variations in how individuals with increasing anxiety symptomatology described and assessed the phenomenology of upward and downward CFT compared to their recalled memories. We made four predictions: relative to participants with lower trait anxiety, participants with higher trait anxiety would have (1) more negative and (2) more general (i.e. less concrete) memories and CFT. Across participants, (3) CFT would be less detailed and vivid than memories and, (4) valence would be most negative for downward CFT, then recalled memories, then upward CFT.

The first prediction was supported by the text analyses: the number of negative emotional words used to describe each mental simulation correlated with participant trait anxiety. Based on work in linguistic emotion regulation, this suggests that participants with lower anxiety were better at regulating their emotions while describing negative events (Nook et al., 2017). Interestingly, participants with higher anxiety did not rate these memories’ valence as more negative than those with lower anxiety and, surprisingly, rated the intensity of these simulations as lower than participants with lower levels of anxiety. Together, these results suggest that people with high anxiety perhaps were unaffected by the negative words used in their descriptions or had different meta-cognitions of what constituted a high score in emotional valence or intensity. Participants with higher anxiety also used more positive words in their upward CFT, suggesting a general increase in task-appropriate word use.

Second, we predicted that participants with higher levels of anxiety would have more general simulations

than their lower-anxious peers. This hypothesis was supported by ratings given during initial memory collection: participants with higher anxiety levels reported lower detailed memories at baseline, suggesting that their memories are retrieved with less specificity than their lower-anxious peers. This result is consistent with studies showing that participants with mood and anxiety disorders report reduced detail and specificity in memories (Morgan, 2010; Wessel et al., 2001). After accounting for this baseline difference, a difference in simulation generality across anxiety level was observed only in the phenomenology ratings and only for upward counterfactuals. Specifically, people with higher levels of anxiety versus lower anxiety reported fewer compositional details in upward CFT. They similarly reported having a worse understanding of how they might have felt during upward CFT compared to lower anxious peers. Perhaps the overgeneralisation of memories seen in psychopathology is an effect of ruminative thinking, where repetitive upward counterfactual creation during rumination contributes to the dulling of compositional and emotional memory details. However, we note that it is difficult to disambiguate whether this lack of specificity is driven by anxiety or by depression, as they are frequently comorbid and we did not assess depression status in the present sample. We consider this a limitation of this study and recognise the need for further studies to explore differential effects of anxiety and depression.

Third, we predicted that recalled memories would be rated as more specific than CFT across all anxiety levels. This prediction was partially supported, as memories were recalled with greater sensory details than downward counterfactuals and greater compositional details than upward counterfactuals, especially for people with higher anxiety. Furthermore, downward counterfactuals were rated as harder to imagine emotionally than memories. These results agree with previous studies suggesting that episodic memories are simulated with greater perceptual details and intensity than counterfactuals (De Brigard & Giovanello, 2012; Johnson et al., 1988). Conversely, measures of linguistic abstractness, which were calculated using the written descriptions of each simulation, were significantly higher for memories than for upward CFT. This contradictory finding may be a result of the way this measure was scored, as it treated nouns and adjectives as most abstract and action verbs as most concrete (Seih et al., 2017). Upward CFT often includes concrete plans to change

behaviour, whereas memory recollection is largely descriptive, causing an unintentional skew in our abstractness measure based on task demands.

Finally, as expected, we found that upward counterfactuals were rated as more positive than either remembered negative memories or downward counterfactuals. However, we found that people with higher anxiety generally reported feeling lower emotional intensity during memory and counterfactual simulations than people with lower anxiety. This finding runs contrary to previous literature showing people with higher levels of anxiety and rumination tend to amplify negative ratings of autobiographical memories (Finnbogadóttir & Thomsen, 2013; Lyubomirsky et al., 1998; Thomsen et al., 2011). Many of these differences in other studies were observed when participants were asked to recall memories freely. By restricting all participants to negative, regretful memories, we may have nullified the negativity bias seen in participants with psychopathology. Furthermore, none of the previous studies examined mental simulations using CFT. Further work is needed to clarify differences in the experience of mental simulation of individuals with anxiety.

Unexpectedly, we found an interaction between simulation type and perceived likelihood of the event. Relative to lower anxiety, participants with higher anxiety believed that the alternative presented in an upward counterfactual thought, but not in a downward counterfactual, was less likely to have occurred. This finding is consistent with work suggesting that people with high levels of anxiety find negative future events to be more probable (Gagne et al., 2018); perhaps by comparison they also find imagined positive past events to be unlikely. This disbelief may prevent people with higher anxiety from learning from their upward counterfactuals; they may not use the simulated information to prepare for similar future scenarios, as they do not believe the more positive scenario will occur (Markman et al., 1993).

Overall, this study provides mechanisms for how counterfactuals may be maladaptive. It adds more nuance to the current literature: previous work suggests that vivid counterfactuals after a traumatic event may heighten symptoms of post-traumatic stress (Blix et al., 2016, 2018), whereas we see that counterfactual thoughts may still be maladaptive if not as vivid as memory recollections. We note that our study is limited by relying on self-report, forced counterfactual creation, and memories that are not very negative or traumatic. Future studies should

compare phenomenology of spontaneous counterfactual thinking using methods where natural behaviour can be captured and more closely monitored.

In sum, we found that participants with higher trait anxiety symptomatology had a harder time creating detailed simulations and had marked phenomenology irregularities specifically associated with upward counterfactuals. This type of CFT is strongly associated with ruminative thinking, so our results provide new evidence into why these thoughts may be functioning differently in low versus high anxious individuals. Future studies can expand these results by including other measures of psychopathology, performing an in-lab or in-context experiment to test directionality, and explicitly recruiting participants that have been clinically diagnosed with a mood or anxiety disorder. It would also be useful to determine whether some of these phenomenological differences across anxiety levels are results of encoding differences, consolidation/reconsolidation changes, or retrieval-level effects. With these findings, we can begin exploring why and how the observed changes lead to maladaptive behavioural outcomes, a discovery that can help clinicians make more informed therapeutic choices when addressing pathological thought processes.

## Note

1. As suggested by a reviewer, we explored gender differences in the data. On average, men scored lower on trait anxiety than women,  $b = -6.64$ ,  $SE = 3.02$ ,  $t = -2.20$ ,  $p = .031$ . Thus, all analyses were also run with gender as a covariate, yielding the same results of interest (see Supplemental Information).

## Acknowledgements

We would like to thank M. Zachary Rosenthal for his contributions to this line of research.

## Data availability statement

The data and full set of analyses that support the findings of this study will be openly available upon publication on github at <https://github.com/IMC-Lab/PhenAnx>.

## Disclosure statement

No potential conflict of interest was reported by the author(s).



## Funding

This research was conducted with Government support under and awarded by the DoD, Air Force Office of Scientific Research, National Defense Science and Engineering Graduate (NDSEG) Fellowship 32 CFR 168a, and a Duke Institute of Brain Science's Incubator Award.

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## Appendix

### Phenomenology ratings

Phenomenology questions	Scale endpoints (1-7)	
How clear was [the simulation]?	Dim	Clear
How much colour was there?	Black & White	Full Colour
How much visual detail?	None	A lot
How much sound?	None	A lot
Smell?	None	A lot
Touch?	None	A lot
Taste?	None	A lot
How vivid was [the simulation]?	Vague	Very Vivid
How was the composition?	Sketchy	Very Detailed
How clear was the location?	Vague	Clear
How clear was the spatial arrangement of objects?	Vague	Clear
How clear was the spatial arrangement of people?	Vague	Clear
How clear was the time of day?	Vague	Clear
Can you imagine how you would have felt during the event?	Not at all	Definitely
What would have been your emotion?	Negative	Positive
What would have been the intensity of your emotion?	Not Intense	Very Intense
What is your emotion as you are thinking about it now?	Negative	Positive
What is the intensity of the emotion as you are thinking about it now?	Not Intense	Very Intense
Overall, how do you imagine this event?	Hardly	Very Well
How likely is it that this event could have happened to you in the past?	Unlikely	Likely
From what perspective do you think about this event?	First, Third, or Other	