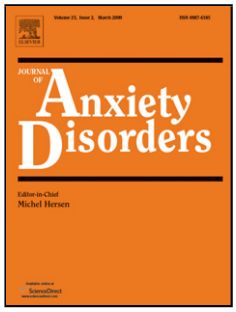

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Episodic Future Thinking in Generalized Anxiety Disorder

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Highlights

There is little knowledge of *episodic* future thinking (EFT) in GAD

- Examined simulations of novel future events in GAD and control participants
- GAD participants spontaneously added less detail to EFT than did controls
- GAD group showed negative bias in ease of generating EFT, perception of plausibility

Abstract

Research on future-oriented cognition in generalized anxiety disorder (GAD) has primarily focused on worry, while less is known about the role of *episodic* future thinking (EFT), an imagery-based cognitive process. To characterize EFT in this disorder, we used the *experimental recombination procedure,* in which 21 GAD and 19 healthy participants simulated positive, neutral and negative novel future events either once or repeatedly, and rated their phenomenological experience of EFT. Results showed that healthy controls spontaneously generated more detailed EFT over repeated simulations. Both groups found EFT easier to generate after repeated simulations, except when GAD participants simulated *positive* events. They also perceived higher plausibility of negative—not positive or neutral—future events than did controls. These results demonstrate a negativity bias in GAD individuals' episodic future cognition, and suggest their relative deficit in generating vivid EFT. We discuss implications for the theory and treatment of GAD.

Keywords: generalized anxiety disorder; episodic future thinking; emotion; cognition

1. Introduction

Over the past 30 years, considerable research has aimed to elucidate the relation of anxiety to future thinking (Miloyan, Pachana, & Suddendorf, 2014). Perhaps one of the most reliable findings to emerge from this literature is the heightened fluency with which anxious individuals, both clinical and non-clinical, think about negative future events. For instance, compared to non-anxious individuals, anxious ones find it easier to generate negative future events (e.g., MacLeod & Byrne, 1996; MacLeod, Tata, Kentish, & Jacobsen, 1997), to generate reasons why those negative events might happen (e.g., MacLeod, Williams, & Bekerian, 1991), and tend to believe that those negative events are more likely to occur in the future (e.g., MacLeod, Byrne, & Valentine, 1996).

In this study, we focus on generalized anxiety disorder (GAD), a psychiatric condition primarily characterized by persistent and excessive worry about the future (DSM-5; American Psychiatric Association, 2013). Dugas and colleagues' model of GAD emphasizes intolerance of uncertainty and maladaptive beliefs (e.g., "worry helps me to plan for the future"; Dugas et al., 1998), which feed into worry, the central feature of the disorder. Although worry has been studied extensively in GAD, there has been no explicit investigation of *episodic* future-oriented thinking— imagining or simulating personal experiences that may take place in the future (Atance & O'Neil, 2001). In the general population, episodic future thinking (EFT) constitutes a substantial portion of cognitive activity (Schacter, Addis & Buckner, 2008; D'Argembeau, Renaud & van der Linden, 2011), and helps us to plan for future situations, facilitate goal-attainment, and improve coping (Schacter, 2012; Szpunar, 2010). It is an important cognitive process in all populations, and alongside worry, EFT may also be a part of the future-oriented cognitive milieu of GAD. A more complete understanding of future-oriented thinking in GAD requires the examination of EFT in this population.

It is important to highlight the possible distinction between worry and EFT, which is potentially important for understanding future thinking in GAD. Worry in the context of GAD is a type of future-oriented thinking style analogous to rumination (Nolen-Hoeksema, Wisco & Lyubomirsky, 2008), involving negative content in predominantly general and abstract verbal loops, lacking specific and concrete details (Dugas et al., 1998). Both Dugas and colleagues' (1998) and Borkovec & Inz's (1990) models of GAD conceptualize worry as an avoidance strategy that distracts one from physiological reactions to fear provoking imagery. That is, worriers worry in order to *avoid* the vivid experience of negative emotional material (Stöber & Borkovec, 2002); by spontaneously engaging in worrying, individuals with GAD rely on abstract semantic material to distract from concrete simulations of events (i.e., EFT) that may bring about physiological symptoms (Borkovec, Alcaine & Behar, 2004; Borkovec & Inz, 1990; Tucker & Newman, 1981). In support of this model, there is evidence that worrisome thoughts are less concrete (e.g., Stöber & Borkovec, 2002), people experience less imagery when worrying (e.g., Paivio, 1986), generating imagery is more distressing than generating verbal material about a worrisome event (Nelson & Harvey, 2002), and worrying suppresses heart rate increases in the face of social stress, hindering full emotional processing (e.g., Borkovec & Hu, 1990; Borkovec, Lyonfields, Wiser, & Deihl, 1993; Newman, Llera, Erickson, Przeworski, & Castonguay, 2013; Peasley-Milkus & Vrana, 2000). In contrast to worrying, EFT is a future-oriented thinking style that relies on concrete imagery and specific details—the very cognitive features that worry is theorized to work against. Currently, we do not know whether and how episodic future events are processed in GAD, because research has focused on more abstract future thinking (i.e. worry). Given the prominence of EFT as a cognitive process in general, as well as the fact that worry and

EFT may be competing processes, a better understanding of EFT in GAD may contribute to the theory and treatment of excessive worry.

We were therefore motivated to characterize EFT in individuals with GAD. Specific questions included: 1) Are individuals with GAD any more or less able to engage in EFT than healthy individuals, and if so, is their ability modulated by emotional valence? 2) Are there differences between how healthy and GAD individuals perceive the plausibility of simulated events? 3) Given that repeated thoughts about the future enhance the perceived likelihood or plausibility of occurrence of events (e.g., Anderson, 1983; Carroll, 1978; Szpunar & Schacter, 2013), does repeated simulation about a specific event increase GAD individuals' perception of its plausibility?

Another aim of the present study was to address a methodological concern in the clinical future thinking literature. A limitation of prior work is that little or no control was exerted over the frequency with which people may have thought about particular events before entering a laboratory setting (e.g., Miranda, Fontes, & Marroquin, 2008; Behar et al., 2012; MacLeod & Byrne, 1996). It remains unclear whether findings of negative bias in future thinking arise from a general bias (e.g., "my financial future will always be bleak"), or from an accumulation of past worrying experiences about this particular event (e.g., worrying about paying bills each month). Therefore, a secondary motivation for the present study was to examine anxious individuals' processing of *novel* future events, so that their ratings reflect cognitive tendencies rather than past experience.

Based on prior models of GAD, in which verbal-linguistic processing is used to dampen vivid simulation of feared future events (for a recent review, see Behar, DiMarco, Hekler, Mohlman, & Staples, 2009), we predicted individuals with GAD to simulate future events with

less detail, ease, and arousal than healthy individuals (i.e., they would be less able to generate vivid events), especially for negative future events. We also predicted that individuals with GAD would selectively rate negative events, and not neutral or positive events, as more plausible than would controls, based on previous findings that anxious individuals perceive the future more pessimistically (Miranda, Fontes, & Marroquin, 2008). We finally predicted that repeated simulations of negative future events would increase GAD individuals' perception of their plausibility, more so than for healthy individuals.

2. **Material and methods**

2.1 Participants

Participants were 40 adults recruited from the Boston community via flyers and online bulletin boards. Those for the GAD group and control group were recruited using separate materials advertising for worriers and healthy volunteers, respectively. To determine eligibility, participants were first administered a 10-minute phone screen to assess for inclusion and exclusion criteria. If eligible, potential participants were invited to the laboratory, where they provided written consent in a manner approved by Boston University's (BU) institutional review board. A doctoral-level student clinician then conducted a diagnostic assessment with all potential participants to determine the presence or absence of GAD diagnosis. Individuals were excluded and debriefed if they failed to meet inclusion and exclusion criteria.

Twenty-one participants met DSM-5 diagnostic criteria for GAD, and 19 did not. They were 70% female, with ages ranging from 18 to 60; there were no differences between the GAD group and the control group in age, $t(38) = 0.50$, $p = .62$., gender, $\chi^2(1, N = 40) = 0.84$, $p = .55$, or level of education, $\chi^2(1, N = 40) = 0.90$, $p = .58$ (Table 1). Potential participants were exclud-

ed if they were younger than 18 years of age, met diagnostic criteria for a serious psychiatric disorder (including bipolar disorder, psychotic disorders and substance use disorders), or had cognitive deficits that precluded them from adequately following experimental instructions. Depression and other anxiety symptoms were allowed for all participants, as long as GAD was the principal diagnosis for those in the GAD group, and GAD (clinical or subclinical) was absent from those in the control group. None of the participants in the control group met diagnostic criteria for any psychiatric disorders.

2.2 Measures

The clinical interview consisted of the Anxiety and Related Disorders Interview Schedule – Fifth Edition (ADIS-5, Brown & Barlow, 2013), a semi-structured, clinician-administered diagnostic interview that assesses presence of anxiety-related psychological disorders. In addition, the following self-report instruments were administered:

Demographics Questionnaire—a brief questionnaire of subjects' age, sex, handedness, ethnicity/race, marital status, education level, and occupational status.

Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990)—a widely used, 16-item questionnaire that assesses worry-related GAD symptoms on 5-point Likert scales that reflect participants' level of agreement with symptom statements. This self-report instrument has demonstrated high internal consistency (α = .86–.95) and test-retest reliability (r = .74–.93; Molina & Borkovec, 1994).

Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988)—a widely used, 21-item questionnaire that assesses severity of physiological and emotional anxiety symptoms in the past

week, based on Likert scales of 0-3. This self-report instrument has demonstrated high internal consistency (α = .92) and test-retest reliability (r = .75; Beck, Epstein, Brown, & Steer, 1988).

2.3 Procedure

After participants completed the clinical interview and the self-report questionnaires, we administered the experimental recombination procedure, which uses details from the participant's life to ensure that they simulate novel events that could take place in their future (Addis et al., 2009; Addis, Musicaro, Pan, & Schacter, 2010; Szpunar, Addis, & Schacter, 2012). This procedure consisted of 3-sessions spanning approximately one week in duration.

Session 1. A research assistant guided participants in generating lists of 110 familiar people (first and last names of people known in real life), 110 familiar places (specific locations that participants had previously visited, e.g., "New England Aquarium"), and 110 familiar objects (objects participants could imagine physically carrying with them in various locations, e.g., "teddy bear"). Participants were instructed to select locations that were specific (e.g., "Boston" would be too general), and to select objects that were portable (e.g., "bed" would be unacceptable). The duration of this first session was approximately 3 hours. After participants left the laboratory, we examined the generated lists for quality based on the above specifications. The first 93 items meeting specification from each of the three lists (i.e., people, places, and objects) were selected and randomly combined to create 93 person-location-object triads to serve as simulation cues to be used in Session 2 (e.g., John Doe + Barnes and Noble bookstore + eyeglasses).

Session 2. Session 2 occurred one week after Session 1 and lasted approximately 1 hour. During this session, participants were asked to "imagine as vividly as possible" hypothetical experiences in response to their idiosyncratic simulation cues. Each participant first completed three practice trials. For each practice trial, participants were presented with one of three valence

tags (positive, negative or neutral) accompanied by a unique person-location-object triad, (e.g., John Doe + Barnes and Noble bookstore + eyeglasses). They were allotted 12.5 s to simulate an experience that could occur within the next 5 years, that involved interacting with the specified person in the specified location in a manner that involved the specified object, and that would evoke the emotion specified by the valence tag. Participants were instructed to generate a detailed episodic experience for each cue and to "do their best in imagining what it would be like." After doing so, they typed a brief one-sentence description of the generated event before moving onto the next simulation cue (e.g., "I ran into John Doe at the Barnes & Noble bookstore and he said my new glasses are ugly"). During the three practice trials, participants worked together with the experimenter to make sure that they understood all instructions. After the practice trials, participants completed 90 additional trials (30 positive, 30 neutral and 30 negative) independently, prompted by a computer program. The positive, negative, and neutral valence tags and simulation cues were presented in random order. Cues were presented with E-Prime software Version 1.0 (Psychology Software Tools, Pittsburgh, PA) on a desktop monitor, and participants used a keyboard to enter their event descriptions.

Session 3. On the day immediately following Session 2, participants returned to the laboratory for a final visit lasting approximately 1.5 hours. During this session, participants first re-simulated half of the previously generated events (15 positive, 15 negative, and 15 neutral, randomly selected) three times each in random order. Each of the 135 trials was performed in the same manner as in Visit 2, with the following exception. In order to ensure that participants simulated the same events they had generated the day before, each trial featured a valence tag, a person-location-object-triad, *and* the participants' previously generated one sentence description. Participants were instructed to simulate each event as they had the previous day without generat-

ing additional details. After a 10-minute break, participants were told that they would re-simulate all 90 events one more time (30 positive, 30 negative, 30 neutral; half simulated for the first time that day and half simulated for the fourth time; presented in random order and completed in the same manner as simulations carried out in Session 2), and that after each trial they would be required to (1) specify whether or not each event had been simulated ten minutes earlier (i.e., yes/no recognition) and (2) complete five phenomenological ratings about the simulated event, each on a 5-point scale: a) plausibility (1 = very implausible, 5 = very plausible); b) detail (1 = few details, 5 = many details); c) ease of simulation (1= very difficult, 5 = very easy); d) valence (1 = very negative, 5 = very positive); and e) arousal (1 = very calming, 5 = very arousing). The order in which these five phenomenological ratings were made was random across participants.

We note that the yes/no recognition test served as a cover story to obscure our intention to assess the effects of repeated simulation on plausibility and other phenomenological ratings. Participants used a keyboard to make their memory judgments and phenomenological ratings. Participants were debriefed and compensated for their time.

By only asking participants to make phenomenological ratings once (i.e., at the end of the experiment), we were able to avoid potential biases associated with rating the same event multiple times (e.g., participants may attempt to remember prior ratings of an event when making subsequent ratings). Also, although participants simulated events once or four times on the day that phenomenological ratings were collected, each event had been simulated once the day before, when brief descriptions of these events were first generated. Hence, distinct sets of events were simulated twice or five times, but once or four times on the day of the critical manipulation.

2.4 Data Analysis

The experiment involved a 2 (Group: GAD vs. healthy controls) x 2 (Repetition: One vs. four simulations on the final day of the experiment) x 3 (Emotion: positive, neutral, negative) design. Group was a between-subject factor, and Repetition and Emotion were within-subject factors. Primary outcomes were participants' subjective ratings of detail, ease of simulation, arousal, and plausibility. Separate repeated measures analyses of variance (ANOVA) were conducted for each of the main outcome variables. Ninety-five percent confidence intervals (95% CI) reflect unstandardized mean differences, as all outcomes are reported on the same scale. Cohen's *d* was calculated using standard deviation (SD) of paired mean differences for within-group t-tests, and using SD of healthy control group means for independent sample t-tests.

3. **Results**

Table 2 presents the mean ratings for positive, negative, and neutral simulations of future events as a function of group membership and repetition. A manipulation check using ratings of valence showed that participants generated EFTs with appropriate valence tags. That is, positive (M = 3.67) events were rated as more positive than negative (M = 2.22) and neutral (M = 3.20) events, $t(39) = 12.30$, $p < .001$, 95% CI [1.213, 1.691], $d = 1.945$ and $t(39) = 7.57$, $p < .001$, 95% CI [0.346, 0.593], $d = 1.214$, respectively; neutral events were also rated as more positive than negative events, $t(39) = 11.73$, $p < .001$, 95% CI [0.812, 1.151], $d = 1.855$. The recognition memory test yielded high levels of accuracy in the GAD group (M = 90.90%, SD = 15.06%) and the control group (M = 96.50%, SD = 4.55%), $t(38) = 1.55$, $p = .13$, $d = -0.50$, indicating that participants in both groups were paying adequate attention to the task.

To test our prediction that individuals in the GAD group would generate less vivid simulations, repeated measures analyses of variance (ANOVA) were conducted on the phenomenological ratings outcomes—detail level, ease of simulation and arousal. There were no main effects of group membership for any of these outcomes. However, there was a group by repetition interaction for ratings of detail level, $F(1,38) = 5.79$, $p = .021$, $\eta_p^2 = .132$, such that individuals with GAD exhibited smaller increases in detail with repeated simulation ($M_{DIFFERENCE} = 0.33$) than controls ($M_{DIFFERENCE} = 0.76$), $t(38) = 2.35$, $p = .026$, 95% CI [0.168, 0.693], $d = .627$ (Figure 1). In addition, we found a three way interaction between group, emotion, and repetition for ease of simulation, $F(2,76) = 6.19$, $p = .004$, $\eta_p^2 = .132$. Specifically, both groups found it easier to simulate repeated events than non-repeated events, with large effect sizes ($0.82 < d\text{s} < 0.99$, $p\text{s} < .001$), *except* when individuals with GAD simulated positive events, where the increase in ease ratings from non-repeated to repeated simulation had only a medium effect size and was not statistically significant, $t(20) = 2.06$, $p = .06$, 95% CI [0.004, 0.576], $d = .449$. As depicted in Figure 2, controls generally had a bigger increase in ease ratings from non-repeated to repeated simulations, but the difference between groups was particularly pronounced for positive events.

A repeated measures ANOVA also tested our predictions that the GAD group would selectively rate negative events as more plausible and increasingly so with repetition. Group interacted significantly with emotion for plausibility ratings, $F(2,76) = 4.08$, $p = .025$, $\eta_p^2 = .180$. As depicted in Figure 3, the difference in negative event ratings between the GAD group ($M = 2.42$) and the control group ($M = 2.17$) produced a medium effect size ($d = .459$), which was significantly larger than the difference in positive ($M_{GAD} = 2.55$ and $M_{CONTROL} = 2.59$; $d = .048$) and neutral ($M_{GAD} = 2.66$ and $M_{CONTROL} = 2.64$; $d = .089$) event ratings. Exploratory Pearson's correlations found a positive relationship between participants' average plausibility ratings and his/her

average detail and ease ratings, r = .699, n = 40, p < .001, and r = .369, n = 40, p = .018, respectively. The plausibility "change score" (repeated - non repeated) was also positively related to detail and ease "change scores," r = .418, n = 40, p = .007, and r = .378, n = 40, p = .015, respectively.

Using the total sample, exploratory repeated measures ANOVAs showed a strong effect of emotion for ratings of detail, arousal, and plausibility, all Fs(2,76) > 9, ps < .001, η_p^2's > .34. Specifically, positive (M = 3.23) events were rated as more detailed than negative (M = 3.04) and neutral (M = 3.09) events, t(39) = 3.84, p < .001, 95% CI [0.087, 0.283], d = .605 and t(39) = 2.94, p = .006, 95% CI [0.046, 0.244], d = .469, respectively; positive (M = 1.79) and negative events (M = 2.32) were both rated as more arousing than neutral (M = 1.62) events, t(39) = 2.74, p = .009, 95% CI [0.045, 0.300], d = .433 and t(39) = 7.45, p < .001, 95% CI [0.512, 0.893], d = 1.178, respectively; and negative events were rated as more arousing than positive events, t(39) = 6.40, p < .001, 95% CI [0.362, 0.697], d = 1.011. Positive (M = 2.56) and neutral events (M = 2.67) were both rated as more plausible than negative events (M = 2.30), t(39) = 4.82, p < .001, 95% CI [0.155, 0.379], d = .761 and t(39) = 6.41, p < .001, 95% CI [0.488, 0.253], d = 1.010, respectively. There were no significant main effects of emotion for ease of simulation, F(2,76) = 2.25, p = .12, η_p^2 = .108. There was also a main effect of repetition such that future events simulated four times were rated as more detailed, easy to simulate, positive, and plausible than future events simulated only once, all Fs(2,38) > 8.80, ps < .005, η_p^2's > .185. There was no effect of repetition on ratings of arousal, F(2,76) < 0.01, p = .96.

4. **Discussion**

We made use of a novel experimental recombination procedure in order to characterize the way individuals with GAD engage in episodic simulation of novel, personalized future events, in terms of vividness and plausibility. The current study extends previous research on future thinking and anxiety in several ways. We instructed and gave opportunity for participants to engage in truly *episodic* simulation, measuring both phenomenological ratings and ratings of perceived plausibility; we also ensured that each participant had personalized, novel events to simulate, in order to control for familiarity with experimental stimuli. Moreover, this is the first study to examine EFT in a GAD sample. We predicted that individuals with GAD would simulate future events less vividly (i.e., with less detail, ease, and arousal) than non-anxious individuals, especially for negative future events; on the other hand, we also predicted that they would rate negative events as *more* plausible than controls. Lastly, we predicted that repeatedly simulating negative future events would make GAD individuals rate them as more plausible, to a greater extent than non-anxious individuals.

The findings in control participants largely replicated a previous study using the experimental recombination procedure in healthy individuals (Szpunar & Schacter, 2013). Findings also partially supported our specific hypotheses. We did not find main group differences in vividness or quality of simulations (i.e., level of detail, ease of simulation, and arousal). However, we found that the GAD group showed less increase in detail after repeated simulations than individuals without GAD. Notably, non-anxious participants spontaneously added details to simulations even though they were instructed not to do so, similar to previous findings in a healthy sample (Szpunar & Schacter, 2013), while GAD participants did this to a significantly lesser extent. The above interaction between group and frequency of simulation may point to a deficit in

continuing to generate concrete details about a future event after the initial conception. Although future work is needed to expand on this preliminary data, this finding is generally in keeping with prior research demonstrating relatively impoverished future thinking in individuals with GAD (Stöber 1998; Stöber 2000; Stöber & Borkovec, 2002).

Our results also showed that those with GAD also showed a relatively dampened increase in ease of simulation for *positive* events after repetition, relative to controls. Whereas the vast majority of prior work has focused on the manner in which individuals with GAD process *negative* future events (Behar, DiMarco, Hekler, Mohlman, & Staples, 2009), the above results indicate that it is also important to consider the manner in which individuals with GAD think about *positive* future events. Although both groups rated positive events as coming to mind more easily than negative events following a single simulation, this difference was not present after repeated simulation for individuals with GAD. Hence, this finding highlights the need for work that emphasizes deficits of positive cognitions in anxiety disorders (Byrne & MacLeod, 1997; MacLeod, Tata, Kentish, Carroll, & Hunter, 1997). Overall, in characterizing the vividness of EFT in individuals with GAD, our findings suggest that although they are generally able to engage in EFT in a manner similar to that of non-anxious individuals, they are less prone than non-anxious individuals to spontaneously elaborate on episodic simulations, and they do not find positive EFT easier to simulate over time, a benefit that healthy individuals do get from repeated simulation. These findings also lend support to the notion that worry and EFT are distinct processes, given the excess of the former and relative deficit in the latter in the GAD group.

With regard to perceived plausibility of future events, we found that individuals with GAD selectively rated negative events as more likely than did non-anxious individuals, consistent with our second hypothesis. This particular pattern of findings helps to corroborate previ-

ous research in anxious, but non-clinical, samples (Miranda, Fontes, & Marroquin, 2008). We extend those previous findings by using novel future events, which controls for previous experience with experimental stimuli (i.e., previous worrying about those specific events), by ensuring that future thinking was *episodic* in nature, and by using a clinical sample.

Results did not support our hypothesis regarding group differences in how *repeated* simulation would affect plausibility ratings. We had predicted that individuals with GAD would experience a larger increase in perceived plausibility of negative events upon repeated simulation, relative to controls. The data showed the reverse pattern, albeit without reaching statistical significance. That is, controls rated negative events as slightly more plausible if they simulated them repeatedly than if they only simulated them once, but those with GAD did not show this repetition effect. This pattern may be driven by the controls' higher level of engagement with the episodic simulations (i.e., greater levels of detail and ease), which led them to perceive the greater vividness in repeatedly simulated events as greater plausibility. The GAD group, by contrast, may have not experienced negative events as increasingly plausible after repetition because they were not increasingly vivid. In fact, exploratory correlation analyses found a correlation between plausibility ratings and detail/ease ratings, and further, between the change in plausibility ratings and detail/ease ratings. However, to test the effect of vividness of EFTs on their perceived plausibility, further exploration through experimental manipulation is needed.

Overall, the above findings suggest that when it comes to simulating the future, those with GAD demonstrate relatively less ability to engage in vivid EFT, and/or a relative lack of cognitive flexibility across repeated cognitive events, especially if the hypothetical event is positive. This, combined with a tendency to rate negative episodic future events as more plausible, may contribute to the clinical features of GAD. Importantly, these findings suggest that elements

other than worry play a role in the cognitive-affective milieu of GAD, and lends support to the view that worry and EFT are two distinct cognitive processes in this disorder. While those with GAD demonstrate more worry than healthy individuals, they actually engage less in some ways in episodic future simulations.

Limitations of the present findings include their reliance on subjective self-reports. Future investigations could benefit from multi-method assessment of participants' emotional-cognitive responses to episodic simulation of future events. Psychophysiological measures of arousal may supplement self-reported Likert scales, which would serve not only to corroborate ratings, but also to highlight any meaningful discrepancies between subjective and objective measures of emotional response. For example, the lack of predicted group differences in subjective arousal ratings in the present findings may be occluding relatively lower *physiological* arousal in the GAD group—anxious individuals may have been more sensitive to changes in bodily sensations, and interpreted them as more arousing than their healthy counterparts. Another limitation is that depressive symptoms were not considered in the analyses. Although both groups were allowed to have depressive symptoms for inclusion in the study, and no participants in either group met diagnostic criteria for a mood disorder at the time of participation, there is a possibility that the GAD group harbored more depressive symptoms than the control group, which may have influenced EFT outcomes. Similar consideration should be given to the potential influence of comorbid anxiety symptoms (e.g., social anxiety), especially in the context of simulating interpersonal future events. Future work should quantify depressive symptoms and other anxiety disorders in more detail in order to consider their role as a possible moderator. Lastly, given the lack of consistent results for all outcome variables (e.g., no findings for arousal ratings) in the predicted pat-

terns, replication is needed to corroborate findings, ideally with larger sample sizes that will allow identification of subgroups and moderating variables.

Future studies, in addition to addressing the above limitations and exploring the relationship between future simulations' vividness and plausibility, should explore the potential relevance of these findings to clinical practice. Cognitive-behavioral therapy for GAD often includes imaginal exposure, an exercise in which patients vividly simulate the worst case future scenarios in order to decatastrophize those hypothetical events (Borkovec & Costello, 1993; Ouimet, Covin, & Dozois, 2012). For GAD patients to receive the full benefit from imaginal exposures, clinicians should be aware that they may not be simulating the scenario as vividly as they could, and should continually assess the patient's ability to engage. Moreover, because imagery has a more powerful impact on emotions than do verbal material (Holmes & Mathews, 2005), the imagery rescripting literature posits that the best way to modify negative cognition is not just through verbal challenge, but by using positive imagery to transform intrusive negative imagery and counteract negative schemas (for a review, see Holmes, Arntz & Smucker, 2007). The efficacy of this technique has been demonstrated in posttraumatic stress disorder (Grunert et al., 2007; Arntz, Kindt & Tiesema, 2007), social phobia (Wild, Hackmann & Clark, 2007), major depressive disorder (Wheatley et al., 2007) and other disorders (reviewed in Holmes, Arntz & Smucker, 2007). However, there is currently little emphasis on practicing positive imagery in GAD. In the context of the main treatment goal (i.e., reducing worry), introducing positive simulations could help to maintain treatment gains by: a) teaching patients how to engage in concrete and detailed positive future simulations, which take up mental space for what would otherwise be filled with abstract, verbal loop-based worry; and b) increasing positive affect overall and challenging negative schemas using imagery, which more strongly affects emotions than do verbal thoughts

(Holmes, Arntz & Smucker, 2007). Developing a further understanding of the nature and limits of positive cognition in GAD will continue to aid in its clinical conceptualization and intervention development.

5. **Conclusions**

In summary, the present study is the first to assess the ability of individuals with GAD to construct episodic simulations of idiosyncratic future events. Using the experimental recombination procedure, we demonstrated that individuals with GAD are less likely than their non-anxious counterparts to spontaneously add detail when repeatedly simulating future events, and do not find positive events increasingly easy to simulate as their non-anxious counterparts do. They also selectively rated negative events as more likely than did healthy individuals, without any confounds from past worrying. This finding advances our understanding of future-oriented cognitive processing in GAD and may have implications for clinical practice.

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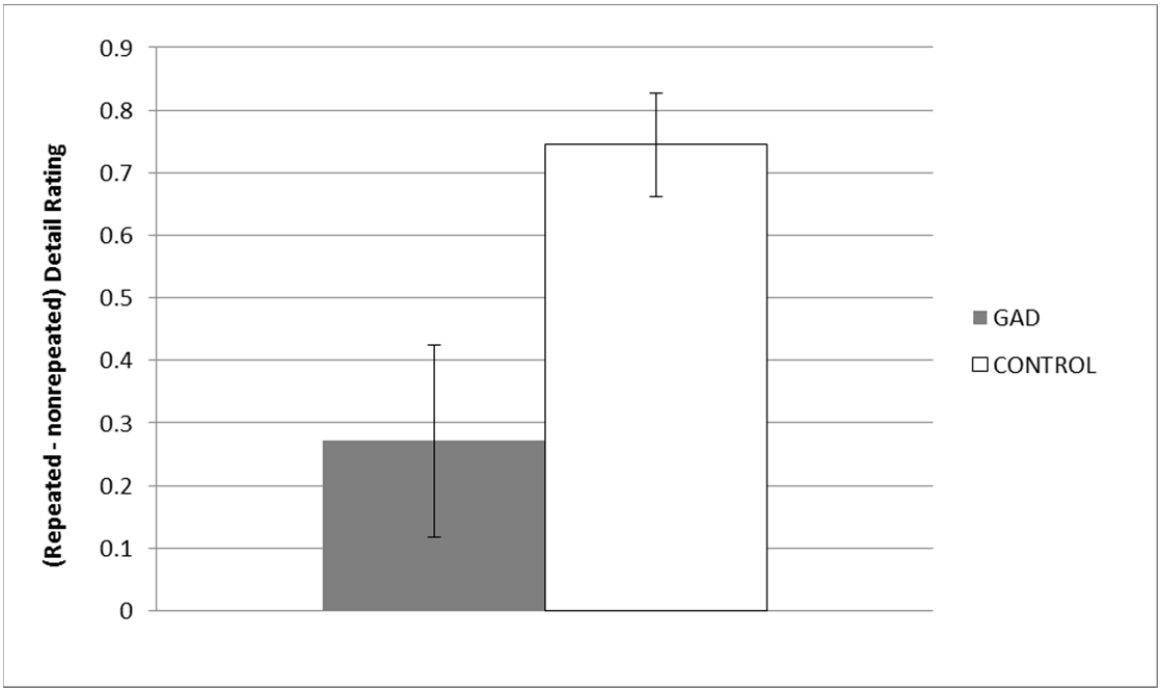
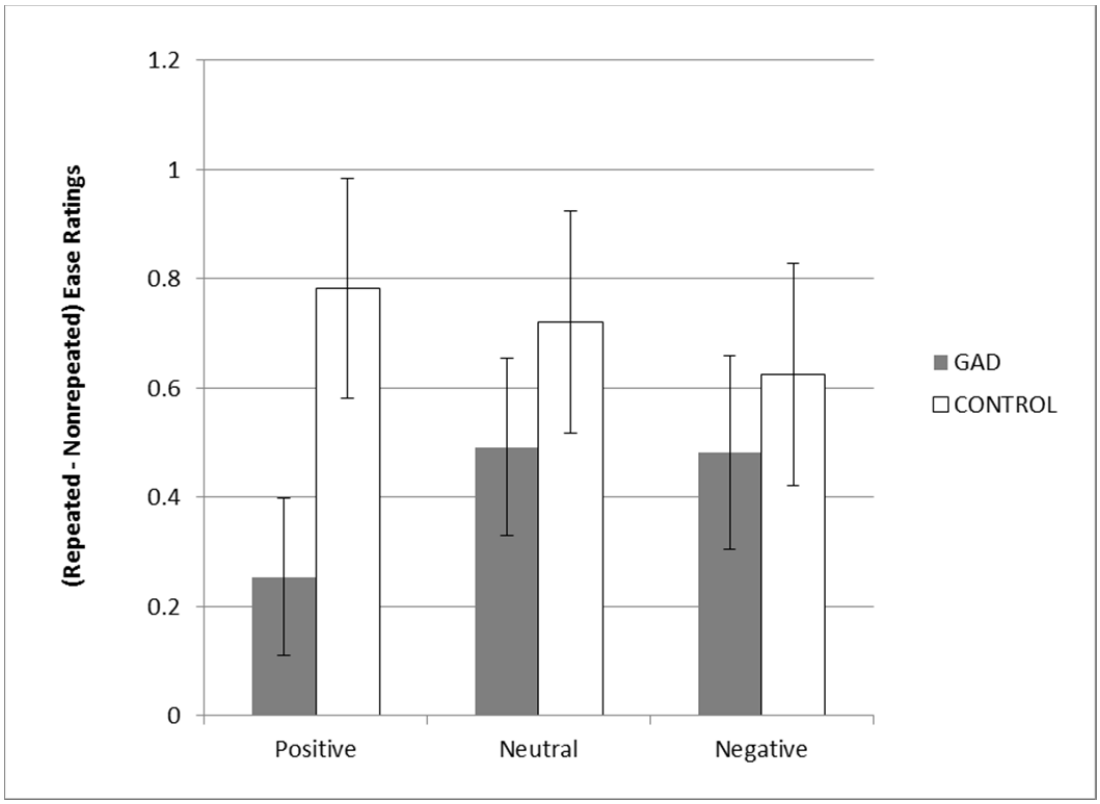
Figure Captions

Figure 1. *Difference in detail ratings between repeated and non-repeated events.*



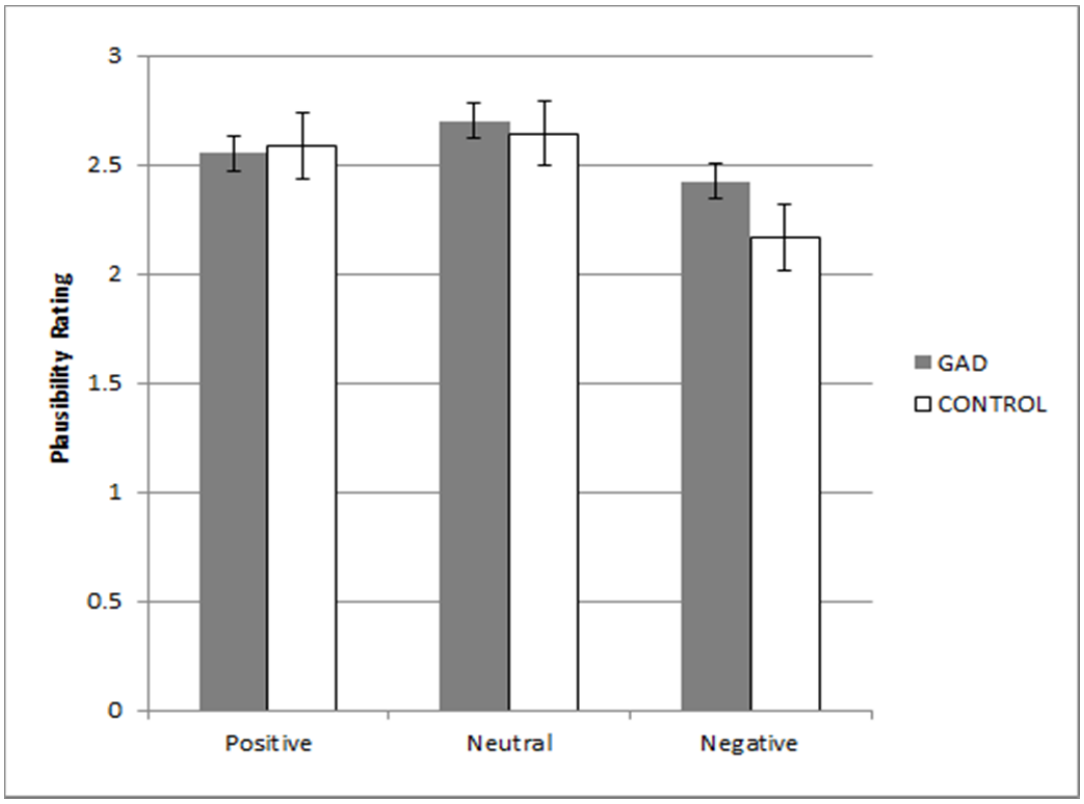
Mean difference between repeated and non-repeated future simulations in ratings of detail. Error bars represent standard errors of the mean. CONTROL = Healthy controls. GAD = Generalized anxiety disorder.

Figure 2. *Difference in ease ratings between repeated and non-repeated events.*



Mean difference between repeated and non-repeated future simulations in ratings of ease of simulation, for positive, negative, and neutral events. Error bars represent standard errors of the mean. CONTROL = Healthy controls. GAD = Generalized anxiety disorder.

Figure 3. *Plausibility ratings by group and emotion of simulated event.*



Mean ratings of plausibility for positive, negative, and neutral events as a function of group membership. Error bars represent standard errors of the mean. CONTROL = Healthy controls. GAD = Generalized anxiety disorder.

Table

Table 1. *Demographic characteristics of patients with GAD and healthy control participants*

	GAD	Controls	Total sample
n	21	19	40
Age	25.67 (11.23)	28.42 (12.35)	27.45 (11.66)
% female	71.40%	68.40%	70.00%
BAI	16.43 (8.23)	2.74 (3.25)	
PSWQ	65.86 (7.42)	39.50 (8.88)	

Note. Standard deviations are presented in parentheses. Controls = healthy controls. GAD = patients with generalized anxiety disorder. The GAD group had higher scores on the Beck Anxiety Index (BAI) than did the healthy control group, $t(38) = 6.79$, $p < .001$). GAD participants also reported more worry on the Penn State Worry Questionnaire (PSWQ) than did controls, $t(37) = 10.10$, $p < .001$, 95% CI [21.94, 30.77], $d = 2.968$.

Table 2. Mean phenomenological ratings for positive, negative, and neutral events as a function of group membership and event repetition

		Controls			GAD			Total		
		Positive	Neutral	Negative	Positive	Neutral	Negative	Positive	Neutral	Negative
Detail	Fourth	3.60 (.72)	3.47 (.76)	3.42 (.89)	3.42 (.65)	3.21 (.62)	3.22 (.70)	3.49 (.68)	3.32 (.70)	3.29 (.79)
	First	2.85 (.87)	2.77 (.86)	2.59 (.79)	3.04 (.69)	2.89 (.57)	2.94 (.66)	2.95 (.77)	2.86 (.71)	2.79 (.74)
Ease	Fourth	3.90 (.77)	3.90 (.82)	3.65 (.94)	3.52 (.67)	3.56 (.84)	3.56 (.84)	3.70 (.74)	3.73 (.80)	3.58 (.88)
	First	3.11 (.84)	3.18 (.86)	3.02 (.77)	3.23 (.65)	3.01 (.73)	3.01 (.73)	3.19 (.74)	3.12 (.75)	3.02 (.74)
Plausibility	Fourth	2.74 (.72)	2.69 (.69)	2.24 (.66)	2.57 (.90)	2.77 (.99)	2.49 (1.02)	2.67 (.82)	2.72 (.85)	2.34 (.83)
	First	2.43 (.79)	2.59 (.70)	2.09 (.54)	2.53 (.80)	2.63 (.84)	2.36 (.83)	2.50 (.79)	2.59 (.76)	2.27 (.73)
Valence	Fourth	3.82 (.49)	3.25 (.34)	2.26 (.48)	3.76 (.38)	3.21 (.31)	2.16 (.53)	3.77 (.46)	3.21 (.32)	2.24 (.50)
	First	3.58 (.53)	3.19 (.33)	2.28 (.36)	3.54 (.41)	3.17 (.20)	2.21 (.49)	3.55 (.47)	3.18 (.27)	2.26 (.45)
Arousal	Fourth	1.88 (.35)	1.67 (.40)	2.24 (.52)	1.72 (.58)	1.53 (.51)	2.43 (.57)	3.21 (.49)	3.39 (.46)	2.69 (.52)
	First	1.86 (.28)	1.53 (.32)	2.28 (.53)	1.71 (.62)	1.55 (.53)	2.31 (.54)	3.20 (.48)	3.34 (.45)	2.72 (.46)

Note. Standard deviations are presented in parentheses. Controls = healthy controls. GAD = patients with generalized anxiety disorder.