Not to Worry: Episodic Retrieval Impacts Emotion Regulation in Older Adults

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Abstract

Interventions that increase the specificity of episodic memory and future-oriented problem solving have been shown to help both young adults and clinical populations regulate their emotions towards potential stressors. However, little is known about how episodic specificity impacts anxiety levels in older adults, who show reduced specificity of episodic memory, future simulation, and problem-solving performance. Although emotion regulation generally improves with age, older adults still experience worries pertaining to their health and interpersonal relationships. The current studies test how episodic specificity affects emotion regulation in older adults. In Experiment 1, participants received an episodic specificity induction (ESI)—brief training in recollecting details of past experiences—prior to generating steps to solve worrisome problems. Older adults provided more relevant steps and episodic details after the specificity induction relative to a control induction, but we found no difference in emotion regulation ratings between induction conditions. In Experiment 2, we contrasted performance on a personal problem-solving task (i.e., generating steps to solve one's own problems) intended to draw on episodic retrieval with an advice task focused on semantic processing (i.e., listing general advice for an acquaintance worried about similar problems). Participants provided more relevant steps and episodic details in the personal problem-solving task relative to the advice task, and boosts in detail were related to larger reductions in anxiety towards the target worrisome events. These results indicate that solving worrisome problems with greater levels of episodic detail can positively influence emotion regulation in older adults.

Keywords

episodic future simulation; episodic specificity induction; aging; worry; means-end problem solving

Much research in the past decade has highlighted the importance of episodic simulation, a form of future thinking or prospection involving the mental construction of a hypothetical future experience (Schacter, Addis, & Buckner, 2008; Szpunar, Spreng, & Schacter, 2014). As posited by the *constructive episodic simulation hypothesis* (Schacter & Addis, 2007, in press), the ability to imagine novel future scenarios is born from our episodic memory

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system's capacity to flexibly retrieve and recombine elements of past experiences. This hypothesis has received support from many studies that highlight the cognitive and neural similarities between episodic memory and episodic future simulation (for recent reviews, see Benoit & Schacter, 2015; Schacter et al., 2012; Szpunar, 2010). Imagining possible future experiences allows individuals to consider different actions and potential outcomes that are inspired by, but not limited to, past experiences, without having to engage in actual behavior (cf., Ingvar, 1979; Schacter, 2012; Suddendorf & Corballis, 1997, 2007). Thus, episodic simulation can serve adaptive functions in a variety of contexts (for reviews, see Schacter, 2012; Schacter, Benoit, & Szpunar, 2017), including in the domain of emotion regulation. The current studies aim to explore a possible beneficial role of episodic simulation in emotion regulation towards worrisome future events in older adults.

Existing research in young adults has shown that constructing a detailed, positive mental simulation of a worrisome future event (e.g., simulating studying behaviors prior to a difficult exam) can improve emotion regulation towards the anticipated event by reducing worry, increasing the subjective probability of a good outcome, decreasing the perceived probability of a bad outcome, boosting positive and minimizing negative affect, and increasing engagement in active coping strategies (Brown, MacLeod, Tata, & Goddard, 2002; Jing, Madore, & Schacter, 2016, 2017; Pham & Taylor, 1999; Taylor, Pham, Rivkin, & Armor, 1998). In particular, the *detail* with which one imagines positive behaviors towards a worrisome future event may have a direct influence on emotion regulation. Two major types of details are relevant: "internal" details involving episodic information about specific people, objects, and actions that constitute an event, and "external" details involving semantic, factual information that is not specific to time and place, commentary, or references to other events (Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002). Patients with emotional disorders, such as depression (Williams et al., 1996) and anxiety disorders (Brown et al., 2014; McNally, Lasko, Macklin, & Pitman, 1995; McNally, Litz, Prassas, Shin, & Weathers, 1994), show reduced specificity (i.e., fewer internal details) when asked to retrieve a memory or simulate a future event. Further, individuals with generalized anxiety disorder worry about the future in the form of negative verbal loops that are abstract and conceptual, lacking the specific, concrete details typically contained in visual imagery and episodic simulations (Borkovec et al., 1998; McGowan et al., 2017; Stöber & Borkovec, 2002). In these emotional disorders, reducing the specificity and concreteness of one's thoughts towards an aversive past or threatening future event may provide immediate relief by avoiding arousing emotional processing of the event (Borkovec et al., 1998; Williams, 2006). However, reduced specificity can result in adverse long-term consequences by magnifying symptoms such as hopelessness and avoidance that hinder the process of imagining the future in a sufficiently concrete fashion to generate specific plans and goals. This, in turn, may hamper problem-solving behaviors and exacerbate existing symptomology (Borkovec et al., 1998; Williams, 2006; Williams et al., 1996). Indeed, in addition to reduced specificity, patients with emotional disorders also show poorer problem-solving performance relative to healthy controls (Dickson & MacLeod, 2004; Goddard, Dritschel, & Burton, 1996; Raes et al., 2005; Sutherland & Bryant, 2008).

Fortunately, manipulations aimed at increasing the specificity and detail of episodic retrieval have beneficial effects on the specificity of future thinking, problem solving, and subsequent emotion regulation. Madore, Gaesser, and Schacter (2014) developed an *episodic specificity induction* (ESI), a brief training in recollecting details of a recent experience that is based on the Cognitive Interview (CI; Fisher & Geiselman, 1992; Memon, Meissner, & Fraser, 2010), a well-established procedure for increasing recall of episodic detail in eyewitnesses. The ESI encourages participants to focus on specific details of a past experience (e.g., a short video they just watched), which selectively biases them to focus on specific event details during subsequent tasks that are dependent on episodic retrieval (e.g., memory, imagination, and divergent thinking tasks), but has no impact on the performance of subsequent tasks that are thought to rely on primarily semantic retrieval or non-episodic narrative processing (e.g., picture description, generating word definitions and object associations; Madore, Addis, & Schacter, 2015; Madore et al., 2014; Madore, Jing, & Schacter, 2016; Madore & Schacter, 2016; for review, see Schacter & Madore, 2016). Madore and Schacter (2014) showed that the ESI boosts the number of relevant steps and details that both young and older adults provide to solve a set of everyday social problems in a means-end problem solving task (MEPS; Platt & Spivack, 1975) relative to a control condition, confirming that episodic retrieval contributes to successful problem solving (see also Sheldon, McAndrews, & Moscovitch, 2011; Sheldon et al., 2015; Vandermorris, Sheldon, Winocur, & Moscovitch, 2013). Jing et al. (2016) replicated and extended these results in a group of young adults by showing that the ESI improved performance on a MEPS task where participants generated steps to solve problems concerning highly worrisome personal future experiences, and further, that this boost in steps and details was linked to improved affect and reduced anxiety towards the target worrisome events. Additionally, recent work has demonstrated that increasing the specificity of autobiographical memory using a Memory Specificity Training protocol (Raes, Williams, & Hermans, 2009) can be linked to improvements in depressive symptoms (Lang, Blackwell, Harmer, Davison, & Holmes, 2012; Neshat-Doost et al., 2012; Raes et al., 2009) and PTSD symptoms (Moradi et al., 2014) with respect to negative and distressing past events (for review, see Hitchcock, Werner-Seidler, Blackwell, & Dalgleish, 2017). Thus, increasing the specificity with which people constructively imagine future experiences serves as a useful intervention to foster productive problem-solving behaviors that can enhance emotion regulation in young adults and in clinical populations.

Despite well-documented effects in young adults, there currently exists very little experimental evidence examining the role of episodic specificity and its influence on emotion regulation in older adults. Older adults are a population of interest because they retrieve fewer episodic event details both when recalling past memories and imagining future events, relative to young adults (Addis, Musicaro, Pan, & Schacter, 2010; Addis, Wong, & Schacter, 2008; Cole, Morrison, & Conway, 2013; Gaesser, Sacchetti, Addis, & Schacter, 2011; Rendell et al., 2012; Romero & Moscovitch, 2012; for reviews, see Schacter, Gaesser, & Addis, 2013; Schacter, Devitt, & Addis, 2018). Furthermore, older adults show deficits in problem-solving performance, relative to young adults (Sheldon et al., 2011, 2015; Vandermorris et al., 2013). As previously mentioned, reduced specificity can hinder the generation of concrete plans and goals to solve a problem and may lead to increased avoidance and rumination, which negatively affects mental health. However, in spite of deficits observed in episodic memory and future thinking in older adults, emotion regulation generally seems to improve with age (for recent reviews, see Scheibe & Carstensen, 2010;

Urry & Gross, 2010). Factors that might contribute to this upward emotional trend in older adults include the positivity effect (i.e., bias towards positive relative to negative information; Carstensen & Mikels, 2005; Mather & Carstensen, 2005; Reed, Chan, & Mikels, 2014), as well as observed differences in the experience, expression, and control of emotions, relative to young adults (Gross et al., 1997). Compared to young and middle-aged adults, older adults show preferential attention towards positive (vs. negative) stimuli (Isaacowitz, Toner, Goren, & Wilson, 2008; Phillips, Henry, Hosie, & Milne, 2008), show improvements in the selection of positive situations that minimize negative emotions (e.g., Carstensen, Fung, & Charles, 2003; Urry & Gross, 2010), and also are better at employing certain emotion regulation strategies such as positive reappraisal (Shiota & Levenson, 2009). Older adults are also reportedly more effective than younger counterparts at handling emotional situations, which likely results from accumulated knowledge and experience in dealing with such situations (Blanchard-Fields, 2007), amongst other theories.

Despite improvements in emotion regulation overall, emotional disorders such as anxiety and depression are still prevalent in older adults (Djernes, 2006; Reynolds, Pietrzak, El-Gabalawy, Mackenzie, & Sareen, 2015; see also Miloyan, Pachana, & Suddendorf, 2016). Because the future is associated with a higher likelihood of negative outcomes such as disease and death, older adults tend to experience a niche of health-related and interpersonal worries (Diefenbach, Stanley, & Beck, 2001; Hunt, Wisocki, & Wanko, 2003; Powers, Wisocki, & Whitbourne, 1992). The Strength and Vulnerability Integration model (SAVI; Charles, 2010) proposes that while older adults effectively regulate lower levels of distress by utilizing the strengths derived with age (e.g., attentional strategies, appraisal, etc.), age-related advantages in emotion regulation tend to reverse in unavoidable negative situations, as in cases where they experience loss of a loved one, loss of social belonging, or encounter functional limitations in their daily lives. Further, when presented with negative events, older adults sometimes resort to more passive forms of emotion regulation (e.g., not directly dealing with issue, avoidance) when compared with middle-aged adults (Blanchard-Fields, Stein, & Watson, 2004), and have been reported to be less flexible in changing emotion regulation strategies across various situations (Eldesouky & English, 2018), which may limit their ability to adapt to and respond in different emotional contexts. These findings, in concert with the observation that older adults show reduced specificity of memory and imagination, suggest that examining older adults’ emotional responses towards worrisome future events that are relevant to their daily lives is an important research question. Thus, the current studies aim to elucidate whether and how encouraging older adults to simulate the future in an episodically detailed manner—specifically during future-oriented problem solving—can improve emotion regulation towards worrisome happenings in their daily lives.

Recently, Jumentier, Barsics, and Van der Linden (2017) explored the impact of episodic specificity on emotion regulation by examining the relationship between different emotion regulation strategies and their influence on the subjective experience (including levels of episodic specificity) of past and future events in middle-aged and older adults. They asked participants to engage in a Specificity Thinking Task (modified from the Autobiographical Memory Test; Williams & Broadbent, 1986), in which they imagined plausible future events in response to word cues varying in temporal distance (near vs. distant future) and emotional valence (positive vs. negative). Participants also completed questionnaires that assessed their general tendencies to engage in experiential and cognitive avoidance (Acceptance and Action Questionnaire; Bond et al, 2011; Cognitive Avoidance Questionnaire, Gosselin et al., 2002) and maladaptive or adaptive emotion regulation strategies (Cognitive Evaluation Regulation Questionnaire; Garnefski, Kraaij, & Spinhoven, 2001). Jumentier et al. (2017) reported that relative to middle-aged adults, older adults provided less specific responses for both negative and distant-future word cues. Older adults who more frequently engaged in positive refocusing (i.e., using pleasant thoughts to replace negative ones, as assessed by the Cognitive Evaluation Regulation Questionnaire) reported higher ratings for the feeling of “pre-experiencing” the future, and marginally reported greater perceived vividness and visual detail of the imagined events. In contrast, in middle-aged adults, the level of experiential avoidance (as assessed by the Acceptance and Action Questionnaire) was negatively related to the specificity of their responses. Further, older adults who engaged in more cognitive avoidance (as assessed by the Cognitive Avoidance Questionnaire) showed higher rates of omission-type responses during the specificity thinking task, such that they were unable to generate any event at all in response to a word cue. Thus, these results suggest a relationship among cognitive and behavioral avoidance, reduced specificity of event responses, and reduced vividness and quality of imagined future events in middle-aged and older adults.

Related work by Leahy, Ridout, Mushtaq, and Holland (2018a) has also examined the impact of autobiographical memory specificity on problem solving and mood in older adults (see also Leahy, Ridout, & Holland, 2018b). They measured autobiographical memory specificity by prompting older adults to recall specific memories in response to cue words on a standard Autobiographical Memory Test (Williams & Broadbent, 1986). The researchers also measured problem-solving ability as assessed by performance on the MEPS task (Platt & Spivack, 1975) and obtained measures of mood using the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). Participants then were assigned to one of three conditions: (1) Memory Specificity Training (MEST; Raes et al., 2009), (2) Life Review (Serrano et al., 2004), and (3) a control group where participants completed a workbook of cognitive stimulating activities such as crossword puzzles that were not tied to autobiographical memory. In the MEST intervention, participants were trained to recall specific event memories in response to emotional and neutral word cues over 4 weeks; this program has previously been shown to successfully boost memory specificity and improve symptomology in clinically depressed participants (Neshat-Doost et al., 2014; Raes et al., 2009) and PTSD patients (Moradi et al., 2014). In contrast, Life Review (Serrano et al., 2004) targets and trains the recall of specific positive autobiographical memories, with the aim of constructing a positive life narrative to improve life satisfaction and reduce depressive symptoms. Leahy et al. (2018a) found significant improvements in both memory specificity and effectiveness of the steps generated in the MEPS task in both the MEST and Life Review intervention groups, relative to the control group, although these effects did not persist during a 3-month follow-up and there were no observed changes in mood (i.e., anxiety and depressive symptoms as assessed by the HADS questionnaire).

Together, the two studies conducted by Jumentier et al. (2017) and Leahy et al. (2018a) successfully manipulated levels of specificity in autobiographical memory and future thinking in older adults, but neither group found reliable links between memory specificity and changes in mood. In both studies, specificity training was implemented on sets of neutral and emotional word cues, and the researchers used questionnaires for global assessments of mood and coping strategies. Given that older adults tend to experience a specific niche of concerns towards the future despite having overall higher levels of emotion regulation relative to young adults, and given that the perceived relevance of problems can affect problem-solving performance in older adults (Artistico, Cervone, & Pezzuti, 2003; Artistico, Orom, Cervone, Krauss, & Houston, 2010), we sought to use a more targeted approach to examine the link between episodic specificity and emotion regulation by implementing trial-level assessments of worry and verified age-relevant problems.

In two experiments, we manipulated levels of episodic specificity during a problem-solving task and examined its subsequent effects on emotion regulation towards future events that older adults find to be worrisome and relevant to their daily lives. We limited our sample to older adults because substantial differences in the types of worries experienced by young and older adults served as an obstacle to comparing and interpreting task performance between the two age groups. Moreover, our goal was not to directly explore variations in the types of worries between the two populations but rather to examine the effect of episodic specificity on worry within an older adult population (however, we note that previous studies have indeed documented differences in the kinds of worries expressed by young and older adults; e.g. Artistico et al., 2010; Powers et al., 1992). In Experiment 1, we used the ESI to boost problem-solving performance on a MEPS task in older adults (cf. Jing et al., 2016; Madore & Schacter, 2014) and assessed emotion regulation towards each individual worrisome event. In Experiment 2, we contrasted levels of episodic specificity and subjective well-being during simulation on a personal MEPS task versus semantic reflection on a novel advice task towards worrisome future experiences. We hypothesized that in both experiments, increasing levels of episodic detail during problem solving should be positively related to improvements in emotion regulation.

Experiment 1

Method

Participants.—We performed a power analysis based on previous related work using the ESI on older adults (Madore et al., 2014) to determine that a sample size of at least 24 useable participants was necessary to observe a medium-sized effect of the ESI on episodic details (power > .80, α = .05, two-tailed, for a within-subjects design, d = 0.60). We based our power analysis on the effect of the ESI on episodic details because there is no existing work that has successfully manipulated episodic specificity in a manner that also impacted subsequent emotional well-being in older adults. Given scheduling constraints with multiple sessions, data collection was stopped once it was determined that approximately enough useable participants had been run to reach this number. A total of 32 older adult participants (ages 65 to 85, M = 74.03 years, 20 female) were recruited from postings around the Greater Boston area and were paid for their participation. All participants had normal vision and no history of neurological or psychological impairment. They were screened with a neuropsychological battery prior to participating in the study and were considered cognitively healthy, with a mean Mini-Mental Status Examination (Folstein, Folstein, &

McHugh, 1975) score of 29.15 (*SD* = .95, range = 27 – 30). Participants were also screened for psychiatric illness and were excluded if they indicated a clinical diagnosis of depression or anxiety, or if they had taken antidepressants or anxiolytics in the past 5 years. Informed written consent was obtained from all participants prior to beginning the study, which was approved by the Harvard University Institutional Review Board. A total of 6 participants were excluded due to attrition (4 participants) or noncompliance (2 participants), leaving 26 participants in the final sample.

Experimental Procedure.—The experiment lasted approximately 4.5 hours across two separate sessions. The durations of the first and second experimental sessions were approximately 2.5 and 2 hours respectively, each spaced 3 to 7 days apart (*M* = 5.41 days). We used a within-subjects design, and the two sessions were very similar in structure: participants first completed an induction phase (specificity vs. control induction), and then completed a problem-solving task involving a series of standardized worrisome future experiences (see Figure 1 for a diagram of the experimental procedure). Both sessions were executed using Qualtrics on an Apple desktop computer, and participants wrote down their responses in a paper packet provided by the experimenter.

In the initial induction phase, participants watched a short video of two adults performing routine activities in a kitchen and then completed a math filler task for 2 minutes; a different video was shown in each experimental session, and the order of the videos was counterbalanced across participants. Afterwards, they either received questions about the video in the form of the ESI or a control induction. In the ESI, participants were probed to recall mental imagery and specific details about the people, setting, and actions in the video, with follow-up questions that asked them to elaborate more on the details they had mentioned. In the other session, they received an impressions control induction, where they were asked questions targeting general impressions, opinions, and thoughts about the video, which allowed them to talk more generally about the video without requiring them to retrieve specific episodic details. Thus, differences in performance on the subsequent tasks should be attributable to changes in levels of episodic detail between the two induction conditions (i.e., more episodic detail with the ESI versus baseline detail with the control induction). The order of inductions was counterbalanced between subjects (see Supplemental Materials for full induction scripts).

After the induction phase, participants completed the MEPS task (adapted from Jing et al., 2016; Platt & Spivack, 1975). In each experimental session, participants viewed 7 standardized worrisome events that concerned their health, interpersonal relationships, and finances (1 event was used as a practice trial). These events were scenarios that 20 separate older adults had most frequently generated during a pilot study, where they were given 30 minutes to write down as many of their future worries and concerns as they could (e.g., overspending their savings for retirement, staying mentally active, growing distant with family, losing their ability to function independently; see Supplemental Materials for a full list of events). For each event, participants were first asked to simulate a scenario in the near future during which they are worrying about the event and were asked to write down their thoughts and concerns about the problem on a sheet of paper for 2 minutes. This 2-minute simulation component served to personalize and acquaint participants with the negative emotions and worry they may feel towards the event, but was not the main focus of the experimental manipulation. Then, they rated each event on a 1 to 9 scale on four dimensions relating to emotion regulation: (1) perceived levels of anxiety, (2) likelihood of experiencing a good outcome, (3) likelihood of experiencing a bad outcome, and (4) difficulty to cope with a bad outcome. Next, participants were asked to directly solve the worrisome problem for 5 minutes. They were presented with a story that described the beginning of the problem (e.g., worrying about the problem) and an ending solution (e.g., achieving the positive outcome specified for the event), and were asked to write down steps they would execute to reach the final solution in each problem in as much detail as possible. They were encouraged to imagine themselves implementing the steps in their mind's eye as they generated the solutions. Finally, participants concluded each event with the same four ratings of anxiety, likelihood of a good and bad outcome, and difficulty to cope with a bad outcome. At the end of the second session, participants completed the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970) to assess levels of trait anxiety.

Coding.—Participant responses from the MEPS task were scored in two ways. Responses were first scored as a "relevant step" or "other step" (Jing et al., 2016; Madore & Schacter, 2014; Platt & Spivack, 1975). Relevant steps are steps or events that lead towards the designated solution state or goal, and other steps are those that lead towards a different solution state not specified in the prompt, or do not fit the step framework (e.g., commentary about the task, repetitive or off-topic information). Participant responses were also scored with the internal and external detail categories of the Autobiographical Interview (AI; see Gaesser et al., 2011; Levine et al., 2002). Internal details included bits of episodic information contained in the responses such as the people, places, actions, objects, thoughts, and feelings of the central event, whereas external details included bits of other information contained in the responses, such as semantic facts, task commentary, and off-topic or repetitive information. Three raters who were blind to the induction condition of the narratives scored participant responses and had high inter-rater reliability for both steps and details (all Cronbach's $\alpha > .93$).

Results

We conducted a series of repeated-measures analyses of variance (ANOVAs) to test our hypotheses, which involved within-subjects factors of Induction (control vs. specificity), Detail type (internal vs. external), Step type (relevant vs. other), and Time of Rating (pre-MEPS ratings after 2-minute worry simulation vs. post-MEPS ratings for perceived levels of anxiety, likelihood of a bad outcome, likelihood of a good outcome, and difficulty to cope with a bad outcome). Both main effects and interactions were tested for each of the variables (see Supplemental Table 1 for main effects), but below we focus on reporting the interactions to address the impact of the induction on each of the variables. All post-hoc t-tests were two-tailed and Bonferroni corrected at the $p < .05$ level. The counterbalanced order of induction and event list presentation did not have a significant effect on the reported analyses (ps > .19).

Changes in Steps and Details by Induction Condition.—To examine the impact of the ESI on the types of steps and details that participants produced, we first conducted a series of 2 (Induction condition: control vs. specificity) x 2 (Step type: relevant vs. other; Detail type: internal vs. external) repeated-measures ANOVAs. We found a significant interaction of Induction condition (control vs. specificity) x Step type (relevant vs. other), $F(1,25) = 47.01$, $p < .001$, $\eta_p^2 = .65$ (Figure 2A). Two-tailed post hoc t-tests showed that participants generated significantly more relevant steps, $t(25) = 6.51$, $p < .001$, 95% CI = [1.29, 2.49], $d = 1.28$, and significantly fewer other steps, $t(25) = -3.85$, $p = .001$, 95% CI = [−1.14, −.35], $d = 0.75$, in the specificity condition relative to the control condition (Relevant steps: $M_{difference} = 1.89$, $SE = .29$; Other steps: $M_{difference} = -.74$, $SE = .19$). We also found a significant interaction of Induction condition x Detail type (internal vs. external), $F(1,25) = 33.28$, $p < .001$, $\eta_p^2 = .57$ (Figure 2B). The specificity induction boosted the number of internal details contained in the solution steps, $t(25) = 5.94$, $p < .001$, 95% CI = [3.03, 6.25], $d = 1.17$, and reduced the number of external details, $t(25) = -3.88$, $p = .001$, 95% CI = [−5.47, −1.68], $d = 0.76$ (Internal details: $M_{difference} = 4.64$, $SE = .78$; External details: $M_{difference} = -3.58$, $SE = .92$). These results are consistent with prior work examining the impact of the ESI on the MEPS task in both young and older adults (Jing et al., 2016; Madore & Schacter, 2014).

Changes in Emotion Regulation Ratings by Induction Condition.—Next, we assessed the impact of the ESI on the 4 ratings pertaining to emotion regulation by conducting a series of 2 (Induction condition) x 2 (Time of Rating: pre-MEPS ratings vs. post-MEPS ratings) repeated-measures ANOVAs. There were no significant differences in initial ratings between induction conditions. Despite boosts in problem-solving performance, we did not observe differential changes in emotion regulation between the ESI and control induction conditions. Overall, we saw decreases in levels of anxiety, perceived likelihood of a bad outcome taking place, and perceived difficulty to cope with a bad outcome, and increases in the perceived likelihood of a good outcome after participants engaged in the MEPS task (Figure 3; see Supplemental Table 2 for mean rating values), but these rating changes were similar after both inductions and did not statistically differ (all *F*s < .69, *p*s > .41; see Supplemental Table 1 for all main effect and interaction values). Trait anxiety was not significantly related to any rating changes. Thus, the observed boosts in episodic specificity and improved problem-solving performance are not related to differential improvements in emotion regulation between the induction conditions.

Experiment 1 Discussion

Overall, the results of Experiment 1 show that the ESI increased the number of relevant steps and internal details that older adults generated while solving problems that they found to be worrisome and relevant to their daily lives, relative to a control induction. The magnitude of this observed increase in steps and details is similar to that previously reported by Madore and Schacter (2014) in older adults. However, contrary to our predictions, we did not observe larger improvements in emotion regulation when participants generated more details in the ESI, relative to the control condition.

Despite structural similarities in the MEPS task concerning worrisome events conducted in young adults by Jing et al. (2016) and in older adults in the current study, we do not think that task performance should be directly compared between the two age groups due to the different nature of worrisome experiences that are relevant to their daily lives (e.g., young adults worry about doing poorly on an exam or a job interview, whereas older adults worry about memory decline and their ability to stay mentally active; see Artistico et al., 2010, for experimental evidence). However, it is worth noting that whereas Jing et al. (2016) reported that the ESI boosted problem-solving performance in young adults by an average of 3.6 relevant steps and 9.68 internal details, it boosted performance in older adults in the current study by an average of only 1.89 steps and 4.64 details (consistent with Madore & Schacter, 2014). Thus, one possibility is that the boost in episodic specificity must reach a certain magnitude before it has perceptible influences on subjective anxiety between induction conditions. Whereas young adults showed more substantial increases in specificity with the ESI and thus reported larger subsequent changes in emotion regulation (Jing et al., 2016), the current boost observed in older adults in Experiment 1 may not have surpassed the necessary threshold. In order to observe changes in anxiety towards worrisome future experiences in older adults, we may need to further amplify differences in episodic specificity and concreteness in problem solving.

Given that the boost in steps and details that is observed after the ESI in Experiment 1 is comparable to increases in episodic specificity in other ESI experiments in older adults (Madore et al., 2014; Madore & Schacter, 2014), it seems that effects of the ESI may have its limits in older adults. In Experiment 2, we aimed to use an alternative method to maximize differences in episodic specificity and concreteness in problem solving by comparing episodic future simulation in the MEPS task with a novel advice task that engaged more semantic reflection, as opposed to detailed episodic retrieval.

Experiment 2

In Experiment 2, we examined the effects of episodic detail during problem solving on subsequent changes in emotion regulation by comparing performance on two tasks: (1) a MEPS task identical to the task in Experiment 1, where participants concretely imagined and generated steps to solve a personal problem (hereafter we refer to this task as the "personal MEPS task"), and (2) a general advice task, which allowed participants to think about ways to solve the problem without retrieving as much concrete, episodic detail (see methods below for a more detailed task description). Whereas participants engaged in episodically detailed problem solving after both the ESI and control inductions (but produced even more episodic detail after ESI) in Experiment 1, participants should provide fewer concrete steps and details in the general advice task, relative to the personal MEPS task in Experiment 2. Thus, this task contrast should yield larger differences in episodic detail than that observed in Experiment 1.

Overall, we predicted that participants would generate more concrete, detailed steps in the personal MEPS task relative to the general advice task, and that we would observe larger improvements in subsequent emotion regulation towards the worrisome future events in the personal MEPS condition relative to the general advice condition.

Method

Participants.—A total of 40 older adult participants (ages 66 to 89, *M* = 73.5 years, 22 female) were recruited from postings around the Greater Boston area and were paid for their participation. All participants had normal vision and no history of neurological or psychological impairment. Participants were screened with a neuropsychological battery prior to participating in the study and were considered cognitively healthy, with a mean Mini-Mental Status Examination (Folstein et al., 1975) score of 29.16 (*SD* = 1.35, range = 25 – 30). Participants were also screened for psychiatric illness and were excluded if they indicated a clinical diagnosis of depression or anxiety. Informed written consent was obtained from all participants prior to beginning the study, which was approved by the Harvard University Institutional Review Board. A total of 8 participants were excluded due to attrition (5 participants) or noncompliance (3 participants), leaving 32 participants in the final sample. To keep the sample size in Experiment 2 comparable to that of Experiment 1, we stopped data collection after reaching the same approximate number of useable participants.

Experimental Procedure.—Experiment 2 lasted approximately 4 hours across two separate sessions (2 hours each) that were spaced 3 to 7 days apart (*M* = 5.43 days). We employed a within-subjects design, and in each session, participants engaged in either a personal problem solving (MEPS) task or a general advice task involving the same set of standardized worrisome future experiences used in Experiment 1; task order was counterbalanced across participants (see Figure 4 for a diagram of the experimental procedure). Both sessions were executed using Qualtrics on an Apple desktop computer, and participants wrote down their responses in a paper packet provided by the experimenter.

In one session, participants completed a personal MEPS task (Platt & Spivack, 1975) that was identical in structure to the task in Experiment 1. Participants viewed 7 standardized worrisome events, 1 of which was used as a practice trial. For each event, participants were first asked to simulate a scenario in the near future during which they are worrying about the event for 2 minutes and rated each event on a 1 to 9 scale for perceived levels of anxiety, likelihood of experiencing a good and bad outcome, and difficulty to cope with a bad outcome. Next, they were presented with a story that described the beginning of the problem (e.g., worrying about the problem) and an ending solution (e.g., achieving the positive outcome specified for the event), and were asked to write down steps they would execute to reach the final solution for 5 minutes. Each event concluded with the same ratings pertaining to emotion regulation.

In the other experimental session, participants completed a general advice task. As in the MEPS task, participants viewed 7 standardized worrisome events, 1 of which used as a practice trial. They were first asked to simulate a personal scenario in which they are worrying about the event happening to themselves for 2 minutes, and rated each event for perceived levels of anxiety, likelihood of experiencing a good and bad outcome, and difficulty to cope with a bad outcome. Next, they were presented with a story about an acquaintance experiencing a problem similar to the one they just described for themselves. Each story described the beginning of the problem (e.g., their acquaintance worrying about the problem) and an ending solution (e.g., their acquaintance achieving the positive outcome specified for the event), and they were given 5 minutes to write down as many pieces of general advice as they could think of to help their acquaintance reach the positive outcome. Each event trial concluded with personal ratings relating to emotion regulation (e.g., anxiety, perceived likelihood of good and bad outcome, and difficulty to cope with negative outcome), in addition to a rating of how similarly they would respond to solve the problem for themselves. Importantly, participants were instructed that the acquaintance they imagined should be a neighbor or a friend whom they know and have interacted with, but that they should avoid thinking about a very close friend or family member. These instructions were given to minimize the extent to which participants identified with their acquaintance, and to reduce the possibility that participants would "put themselves in the other's shoes," given existing literature showing that there is a larger overlap between knowledge and representations of the self and close others (such as a close friend or family member), relative to more distant others (e.g., Aron, Aron, Tudor, & Nelson, 1991; Aron & Fraley, 1999; Bower & Gilligan, 1979; Thornton, Weaverdyck, Mildner, & Tamir, 2018), and that we are more likely to utilize the episodic memory system when we think about more familiar others (Rabin & Rosenbaum, 2012). In contrast to simulating specific, episodically concrete steps to solve a problem in the personalized MEPS condition, the general advice task was designed to encourage participants to reflect upon and estimate ways of solving the problem in a more semantic manner without involving as much episodic detail. This logic is similar to that employed by Gaesser and Schacter (2014), where episodic simulation and concrete imagination of prosocial behaviors was contrasted with an "Estimate Helping" condition, where participants engaged in more semantic retrieval to describe or estimate how someone could be helped. Thus, comparing performance on the personal MEPS and general advice tasks allowed us to isolate processes involved in retrieving specific episodic details. At the end of the second session, participants completed the STAI (Spielberger et al., 1970) to assess levels of trait anxiety.

Coding.—Participant responses from the MEPS and advice tasks were scored in three ways. As in Experiment 1, responses were first scored as relevant steps (e.g., steps that lead the participant closer towards a positive solution) or other steps (e.g., steps that do not lead towards the solution; Platt & Spivack, 1975), and were subsequently scored using the traditional internal detail (e.g., episodic information about the people, places, and actions) and external detail (e.g., semantic facts and commentary) categories of the AI (Levine et al., 2002).

For Experiment 2, we also created a modified version of the AI scoring guidelines. Each internal detail (as defined by Levine et al., 2002) was further segregated by level of concreteness across six different categories: (1) references to specific individuals (e.g., family members, health professionals, etc.), (2) locations (e.g., stores, living- or hobby-related locations), (3) objects and other nouns (e.g., methods of contact, modes of transportation, physical aides, etc.), (4) actions (e.g., types of exercise, actions related to hobbies or health); (5) time descriptors (e.g., specific times, duration, and frequency), and (6) other references to sensory and perceptual detail (e.g., color, texture, etc.; see Supplemental Table 3 for more information about categories and examples). In this framework, more general internal details (e.g., “family”, “store”) would be assigned one point as specified in the original AI protocol, whereas more detailed internal details (e.g., “daughter”, “Walmart”) would be assigned an additional point. We expected that the modified scoring method would provide more information and elicit greater differences in the levels of concreteness and detail contained within participant narratives for both the personal MEPS and advice tasks, compared to traditional AI scoring. Two raters blind to task condition scored participant responses and had high inter-rater reliability for both steps and details (all Cronbach’s $\alpha > .91$).

Results

We conducted a series of 2 (Task: MEPS vs. Advice) x 2 (Step type: relevant vs. other; Detail type: internal vs. external; Time of Rating: pre-task vs. post-task ratings for perceived anxiety, likelihood of a bad outcome, likelihood of a good outcome, and difficulty to cope with bad outcome) repeated-measures ANOVAs to test our hypotheses. Below, we focus on reporting the interactions to examine the impact of task on each of the variables of interest (see Supplemental Table 4 for main effects). Post-hoc t-tests were two-tailed and Bonferroni corrected at the $p < .05$ level. The counterbalanced order of task and event list presentation did not have a significant effect on the reported analyses (ps > .12).

Changes in Steps and Details by Task.—First, we found a significant interaction of Task (MEPS vs. Advice) x Step type (relevant vs. other), $F(1,31) = 51.72$, $p < .001$, $\eta_p^2 = .63$ (Figure 5A), such that participants generated more relevant steps, $t(31) = 8.46$, $p < .001$, 95% CI = [1.70, 2.77], $d = 1.49$, and fewer other steps, $t(31) = -3.40$, $p < .01$, 95% CI = [−.97, −.24], $d = 0.60$, in the personal MEPS task compared to the advice task (Relevant steps: $M_{difference} = 2.23$, $SE = .26$; Other steps: $M_{difference} = -.61$, $SE = .18$). Next, we also found a significant interaction of Task x Detail type (internal vs. external), $F(1,31) = 32.29$, $p < .001$, $\eta_p^2 = .51$ (Figure 5B). Participants generated more internal details, $t(31) = 6.79$, $p < .001$, 95% CI = [4.08, 7.59], $d = 1.20$, and fewer external details, $t(31) = -3.45$, $p < .01$, 95% CI = [−4.47, −1.15], $d = 0.61$, in the personal MEPS task compared with the advice task (Internal details: $M_{difference} = 5.84$, $SE = .86$; External details: $M_{difference} = -2.81$, $SE = .81$). Thus, in comparing the two tasks, we found that participants indeed generated more episodically concrete solutions in the personal MEPS task.

However, it was clear upon reading participant responses that the traditional internal vs. external detail categories of the AI (Levine et al., 2002) did not fully capture differences in concreteness between the task conditions. For example, consider two steps provided by participants in the personal MEPS task and general advice task, respectively: (1) “I will call my daughter once a week using Facetime,” and (2) “I advise my neighbor to take advantage of technology more frequently to contact family.” According to traditional AI scoring, both “daughter” and “family” would be scored as one internal detail each, as would “once a week” and “more frequently”, or “Facetime” and “other technology.” However, “daughter” provides more specific information about the individual than does “family”, and “Facetime” is a very specific form of technology. Thus, we rescored all participant responses using a modified version of the AI (see Coding section above for more detail) to give more weight to more specific internal details. In doing so, we found that participants generated more internal details in the personal MEPS task as compared with the advice task, $t(31) = 9.05$, $p < .001$, 95% CI = [6.77, 10.71], $d = 1.60$ (Figure 5C), which revealed an even greater difference in levels of internal detail ($M_{difference} = 8.74$ details, $SE = .97$) than in Experiment 1 (for modified AI scoring results from Experiment 1, see Supplemental Materials). Thus, the modified AI scoring method captured more subtle nuances in the levels of detail contained in participant narratives between the two tasks. Importantly, we were able to relate this difference in specificity and concreteness to subsequent changes in emotion regulation concerning the imagined worrisome events.

Changes in Emotion Regulation Ratings by Task.—To examine changes in measures of emotion regulation after each task, we conducted a series of 2 (Task: MEPS vs. Advice) x 2 (Time of Rating: before vs. after task) repeated-measures ANOVAs. There were no significant differences in initial ratings between task conditions. Overall, we found significant Task x Time of Rating interactions for changes in ratings of anxiety, $F(1,31) = 41.33$, $p < .001$, $\eta_p^2 = .57$ (Figure 6A), perceived likelihood of a good outcome, $F(1,31) = 10.31$, $p < .01$, $\eta_p^2 = .25$ (Figure 6B), perceived likelihood of a bad outcome, $F(1,31) = 10.70$, $p < .01$, $\eta_p^2 = .26$ (Figure 6C), and perceived difficulty to cope with a bad outcome, $F(1,31) = 14.10$, $p = .001$, $\eta_p^2 = .31$ (Figure 6D). In the personal MEPS condition, compared with the general advice condition, participants reported a larger reduction in anxiety, $M_{difference} = -.94$, $SE = .15$, $t(31) = -6.43$, $p < .001$, 95% CI = [−1.23, −.64], $d = 1.14$, a larger increase in the perceived likelihood of experiencing a good outcome, $M_{difference} = .58$, $SE = .18$, $t(31) = 3.21$, $p < .01$, 95% CI = [.21, .94], $d = 0.57$, a larger reduction in the perceived likelihood of experiencing a bad outcome, $M_{difference} = -.68$, $SE = .21$, $t(31) = -3.27$, $p < .01$, 95% CI = [−1.10, −.26], $d = 0.58$, and a larger decrease in the perceived difficulty to cope with a bad outcome, $M_{difference} = -.61$, $SE = .16$, $t(31) = -3.76$, $p = .001$, 95% CI = [−.94, −.28], $d = 0.66$ (see Supplemental Table 5 for mean rating values).

Further, we found a significant negative relationship between the difference in the levels of internal detail using modified AI scoring (i.e., internal details in personal MEPS condition – internal details in general advice condition) and the difference in the perceived anxiety towards the worrisome events (i.e., change in anxiety rating in personal MEPS condition – change in anxiety rating in general advice condition), such that the greater the boost in detail between conditions, the larger the observed decrease in anxiety towards the worrisome events, $r_s(30) = -.399$, $p < .05$ (Figure 7A). There was also a significant positive relationship between the change in internal detail and the difference in ratings of the perceived likelihood of a good outcome, $r_s(30) = .374$, $p < .05$ (Figure 7B). We found trending negative relationships between changes in internal detail versus difference in ratings of the perceived likelihood of a bad outcome, $r_s(30) = -.348$, $p = .051$ (Figure 5C), and versus differences in ratings of the perceived difficulty to cope with a bad outcome, $r_s(30) = -.328$, $p = .067$ (Figure 5D). Trait anxiety was not significantly related to any changes in ratings.

Although the general advice task encouraged more semantic reflection relative to the personal MEPS task, it is likely that participants still engaged in some degree of simulation while generating steps to help an acquaintance solve a worrisome problem, and that the advice they provided involved similar steps that they would engage in themselves to solve a personal problem. As previously mentioned, after each event in the advice task, participants rated how similarly they would respond to solve the problem for themselves, which we included as a proxy for simulation during the advice task. We found a negative relationship between the similarity of one's own response versus the change in anxiety towards the events in the advice task, $r_s(30) = -.35$, $p = .05$. Thus, the greater the similarity between the advice given to an acquaintance and one's own problem-solving actions, the greater the observed improvements in emotion regulation.

Experiment 2 Discussion

In contrast with Experiment 1, data from Experiment 2 support the hypothesis that greater specificity of problem-solving simulations concerning worrisome events relevant to older adults leads to reduced anxiety and improved emotion regulation towards those events. First, we found that older adults generated more relevant steps and internal details (via both traditional and modified AI scoring) in the personal MEPS condition, relative to the general advice condition. It is worth noting that the advice condition did not induce a state of overgenerality; participant responses in the advice condition consisted of detailed, concrete and actionable steps, but these steps contained fewer descriptors of the highest specificity (e.g., naming individuals, stores, or specifying the exact technology used for communication) than responses in the personal MEPS task. Thus, we think it is unlikely that critical effects from Experiment 2 stem from overgeneral responding in the advice task. Second, participants reported larger improvements in emotion regulation in the personal MEPS condition compared to the advice condition, and these improvements were directly related to the difference in levels of internal detail generated between task conditions. Overall, these results suggest that episodic detail of simulation is positively related to improved emotion regulation across a number of different measures.

General Discussion

Across two experiments, we tested the hypothesis that increasing the level of episodic detail during problem solving in older adults would enhance emotion regulation towards worrisome future events that are relevant to their daily lives. In Experiment 1, we showed that an episodic specificity induction (ESI) successfully boosted the number of relevant steps and internal details that older adults generated during a means-end problem solving (MEPS) task, thus replicating and extending previous results by Jing et al. (2016) and Madore and Schacter (2014). Contrary to our predictions, we did not find greater reductions in anxiety in the ESI relative to the control condition, which we speculated may be related to the observed magnitude of the boost in episodic detail in Experiment 1, which was much smaller than the increase previously observed by Jing et al. (2016) in young adults but was similar to that observed by Madore and Schacter (2014) in older adults. Because evidence suggests that the ESI is limited in the degree to which it boosts episodic detail in older adults, in Experiment 2 we sought to amplify differences in levels of episodic detail by turning to a different task contrast—namely, by comparing older adults' performance on a personal MEPS task (i.e., generating episodically concrete steps to solve one's own problem) with a general advice task (i.e., providing general advice for an acquaintance experiencing a similar problem, which focused on more semantic processing). We found that participants indeed provided more relevant steps and internal details in the personal MEPS task compared with the general advice task, both using the traditional AI scoring framework (Levine et al., 2002) and a modified AI protocol that ascribed greater weight to more specific internal details. The effect sizes for the boost in relevant steps and internal details in Experiment 2 for the personal MEPS vs. general advice task contrast were also numerically larger than those observed in Experiment 1 for the ESI vs. control induction contrast. Further, we found that larger increases in episodic detail in the personal MEPS task relative to the general advice task were linked to larger subsequent decreases in anxiety and improved emotion regulation towards the target worrisome events, which supported our initial hypotheses. In contrast to previous studies that successfully manipulated levels of episodic specificity in older adults but did not find subsequent changes in global measures of mood when using established questionnaires (e.g., Jumentier et al., 2017; Leahy et al., 2018a), in the current experiments we found for the first time that manipulating specificity and assessing changes in anxiety and emotion regulation on the level of *individual* events—particularly those that older adults found to be very worrisome in the context of their daily lives—revealed the relationship that we had predicted. Thus, although emotion regulation improves overall with age due to differential processing and experience of emotional information, and the use of different strategies in the face of emotional situations (Blanchard-Fields, 2007; Gross et al., 1997; Mather & Carstensen, 2005; Scheibe & Carstensen, 2010; Urry & Gross), older adults nonetheless experience a niche of worries primarily related to their health and interpersonal relationships (Hunt et al., 2003; Powers et al., 1992). Our data indicate that increasing the specificity of future-oriented problem solving towards these concerns can alleviate their worry.

Although we created the general advice task to encourage participants to engage in more semantic processing in contrast to concrete, detailed simulation, they likely still engaged in some degree of episodic simulation (e.g., "putting themselves in another's shoes"). We included an indirect measure of simulation in the advice task by asking participants to rate how similarly they would respond to solve the problem for themselves, and found that the more similar the advice provided was to one's own problem-solving actions, the greater the observed reduction in anxiety towards the worrisome event. This finding suggests that the degree to which participants engage in simulation during the advice task is related to the observed changes in subsequent emotion regulation. We also note that differences in self-relevance between the two tasks could have contributed to the observed rating changes. That is, solving personal problems in the personal MEPS condition likely required a greater degree of self-relevant processing than solving others' problems (similar to their own) in the advice task, which in turn may have influenced reported levels of anxiety between the two task conditions. Critically, however, participants engaged in similar processes in the two tasks because of the overlap in their own problems and their acquaintances' problems (as instructed in the task), but generated more episodically detailed and concrete responses in the personal MEPS task relative to the general advice task, thus allowing us to compare this boost in detail to the observed changes in emotion regulation.

Although these data suggest an important role for episodic specificity in emotion regulation towards worrisome future experiences in older adults, we are not claiming that episodic memory is the only form of memory that is involved in future-oriented problem solving. Existing research has highlighted the role of semantic memory in organizing various kinds of future thinking (Demblon & D'Argembeau, 2014; D'Argembeau & Demblon, 2012; Irish & Piguet, 2013; Klein, 2013; Szpunar et al., 2014). Further, reports of general improvements in emotion regulation with age (Scheibe & Carstensen, 2010; Urry & Gross, 2010), despite known declines in the specificity of memory and imagination (Schacter et al., 2013, 2018), hint that there are other factors at play that likely influence emotional responses towards negative or stressful events. For example, compared with young adults, older adults can draw upon more years of accumulated experience when they encounter a negative situation to select the best plan of action (Blanchard-Fields, 2007; Urry & Gross, 2010), which likely taps into their semantic knowledge of which emotion regulation strategies tend to be more effective based on the resolution of similar past scenarios. Nonetheless, the current studies provide evidence for a role of episodic retrieval in problem solving and emotion regulation. An important direction for future research will be to examine how semantic memory and other cognitive processes impact emotional simulations and appraisals of the future in aging and in young adulthood.

Increasing levels of episodic specificity may impact emotion regulation in a variety of ways. It is thought that in many emotional disorders, overgeneral memory and future thinking help patients to avoid the negative physiological arousal associated with visually imagining an aversive past or threatening future event (Borkovec et al., 1998; McGowan et al., 2017; Stöber & Borkovec, 2002; Williams, 2006), which hampers their ability to concretely plan for or solve the problem at hand. However, when participants solve these negative or worrisome problems with higher levels of specificity and concreteness (via the ESI versus control induction, or by contrasting personal MEPS versus general advice task performance), they retrieve more episodic details concerning the objects, location, actions, individuals, and other relations contained within the event, which makes the event more tangible (Schacter & Madore, 2016). Simulations are organized to contain sequences of causally-linked actions that help to yield concrete plans, and the details contained within simulations serve to make an event seem more realistic and plausible by providing more information about how the event might take place, thus enhancing the subjective likelihood that the event will actually occur (Anderson, 1983; Boland, Riggs, & Anderson, 2018; Carroll, 1978; Szpunar & Schacter, 2013). Indeed, in Experiment 2, we found that older adults reported a higher perceived likelihood that a positive outcome would take place and a lower perceived likelihood that a negative outcome would take place when they generated concrete details about a problem-solving plan in the personal MEPS task, relative to when they listed fewer concrete steps in the general advice task. Further, gaining access to relevant, more realistic features of the imagined event may help participants realize that the scenario is not as negative or as unmanageable as it was initially perceived to be. For example, our data showed that participants reported a larger decrease in the perceived difficulty to cope with a bad outcome after thinking about various aspects of a worrisome problem in the personal MEPS condition. Thus, manipulations that boost episodic detail may improve emotion regulation by linking imagined actions that can yield a concrete plan and by favorably changing the perceived plausibility of those actions (Taylor et al., 1998; Taylor & Schneider, 1989). Given that older adults exhibit reduced specificity of autobiographical memory and future thinking (Schacter et al., 2013, 2018), tend to have futures that are increasingly associated with negative outcomes (e.g., disease, death), and are a vulnerable population with a relatively high prevalence of emotional disorders (Djernes, 2006; Reynolds et al., 2015), it is important to continue exploring how improving problem solving and the concreteness of future thinking may benefit their mental health and quality of life (for a related review, see Bahk & Choi, 2017).

This research may have implications not only for aging populations, but also for other clinical populations. The current studies are amongst a body of recent work that has demonstrated that increasing the specificity of autobiographical memory and future thinking can be linked to boosts in problem-solving behaviors (Leahy et al., 2018a; McFarland, Primosch, Maxson, & Stewart, 2017) and improvements in clinical symptoms in depressed and anxious patients (Lang et al., 2012; Moradi et al., 2014; Neshat-Doost et al., 2012; Raes et al. 2009; for review, see Hitchcock et al., 2017). Thus, increasing the specificity with which people imagine future experiences might serve as a useful intervention to foster more constructive problem-solving behaviors that can reduce anxiety in both aging and clinical populations, which highlights the importance of positive and constructive mental future simulations for emotion regulation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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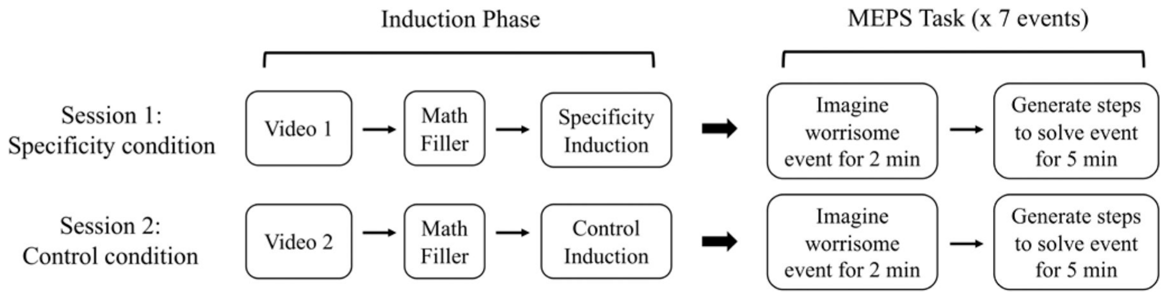

Figure 1.

Schema of experimental design for Experiment 1. The order of induction conditions (specificity, control) was counterbalanced across participants.

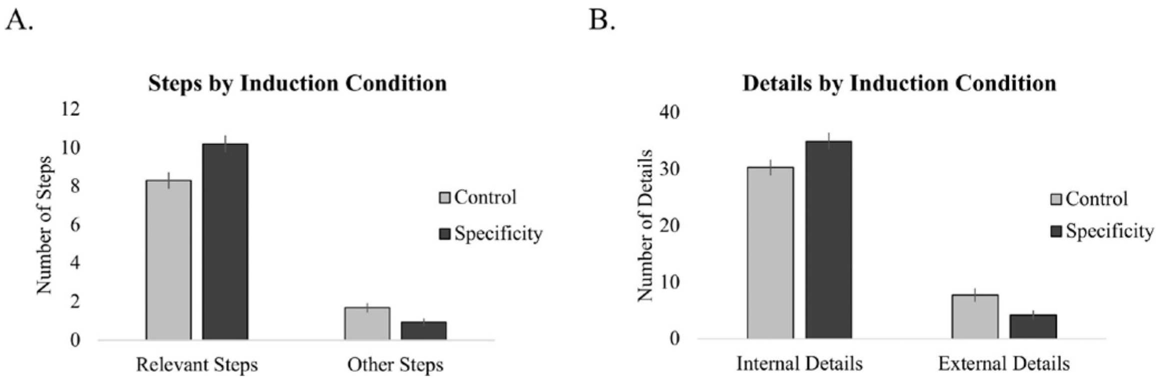

Figure 2.

Experiment 1 mean induction effects (control vs. specificity conditions) on (A) relevant and other steps, and (B) internal and external details. The y-axis represents the mean number of steps or details per trial, and error bars represent one standard error of the mean.

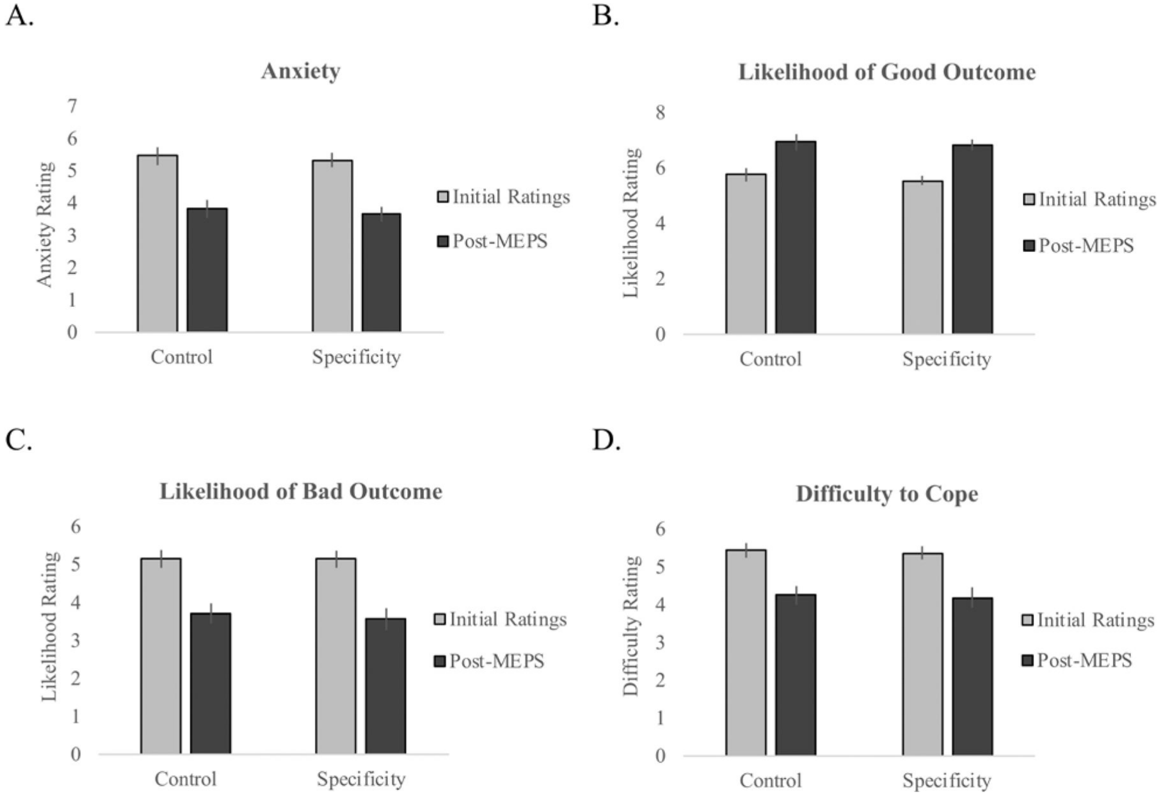

Figure 3.

Experiment 1 mean initial and post-MEPS task ratings in the control and specificity conditions of: (A) anxiety; (B) perceived likelihood of a good outcome; (C) perceived likelihood of a bad outcome; and (D) perceived difficulty to cope with a bad outcome. The y-axis represents the mean rating per trial, and error bars represent one standard error of the mean.

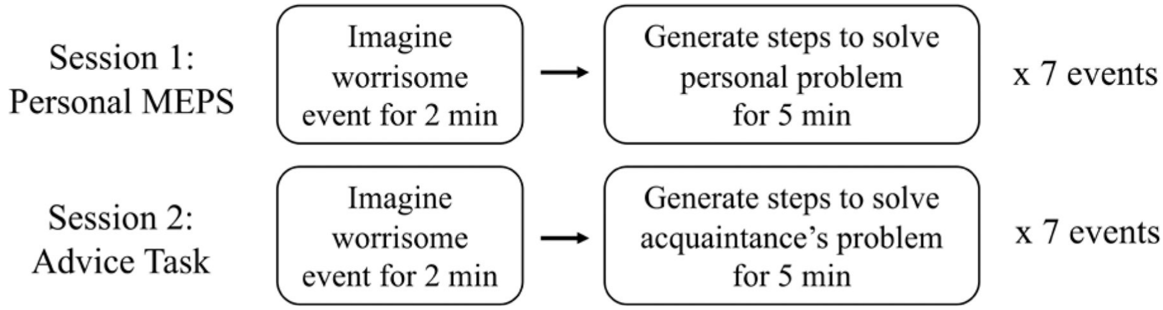

Figure 4.

Schema of experimental design for Experiment 2. The order of task conditions (personal MEPS, advice) was counterbalanced across participants.

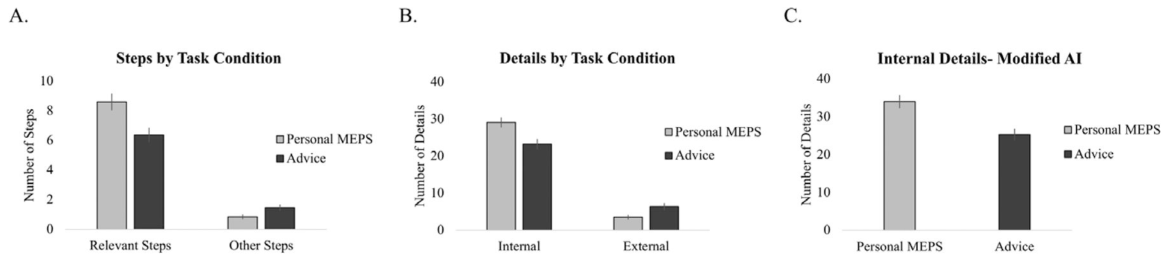

Figure 5.

Experiment 2 mean task effects (personal MEPS vs. general advice task) on (A) relevant and other steps, (B) internal and external details via traditional AI scoring, and (C) internal details via modified AI scoring. The y-axis represents the mean number of steps or details per trial, and error bars represent one standard error of the mean.

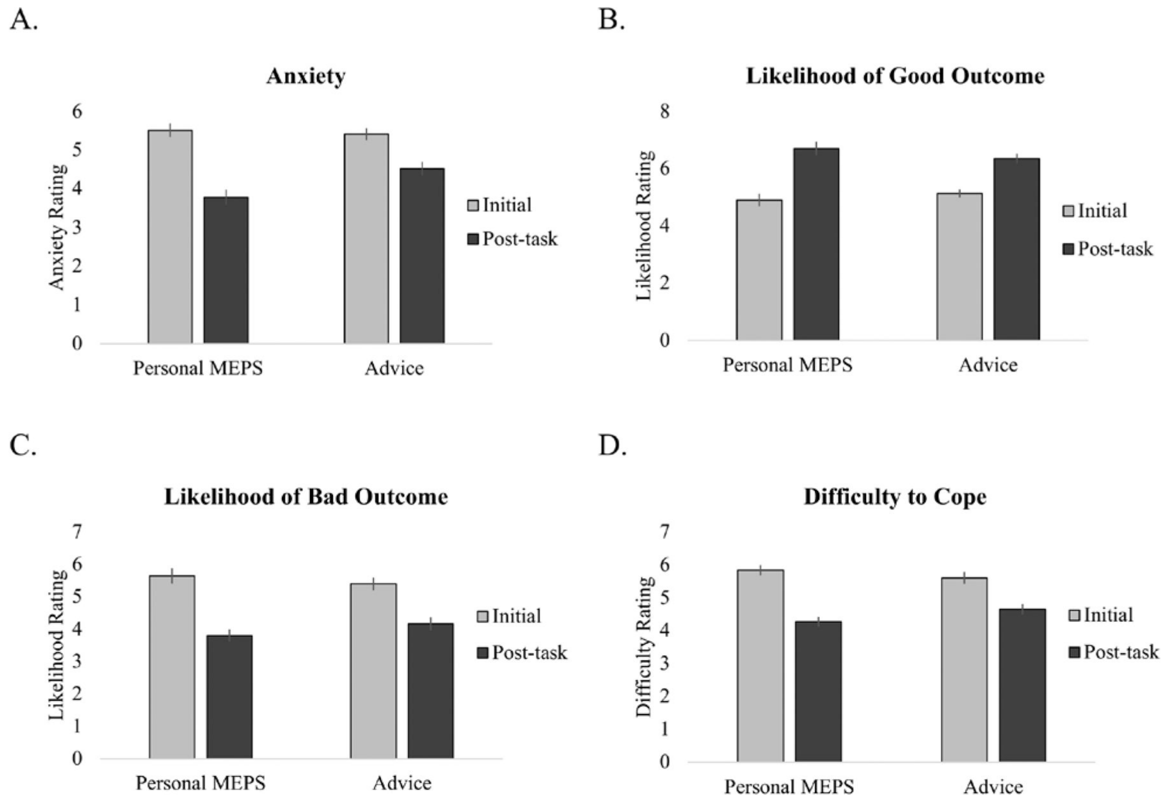

Figure 6.

Experiment 2 mean initial and post-task ratings in the personal MEPS and general advice tasks of: (A) anxiety; (B) perceived likelihood of a good outcome; (C) perceived likelihood of a bad outcome; and (D) perceived difficulty to cope with a bad outcome. The y-axis represents the mean rating per trial, and error bars represent one standard error of the mean.

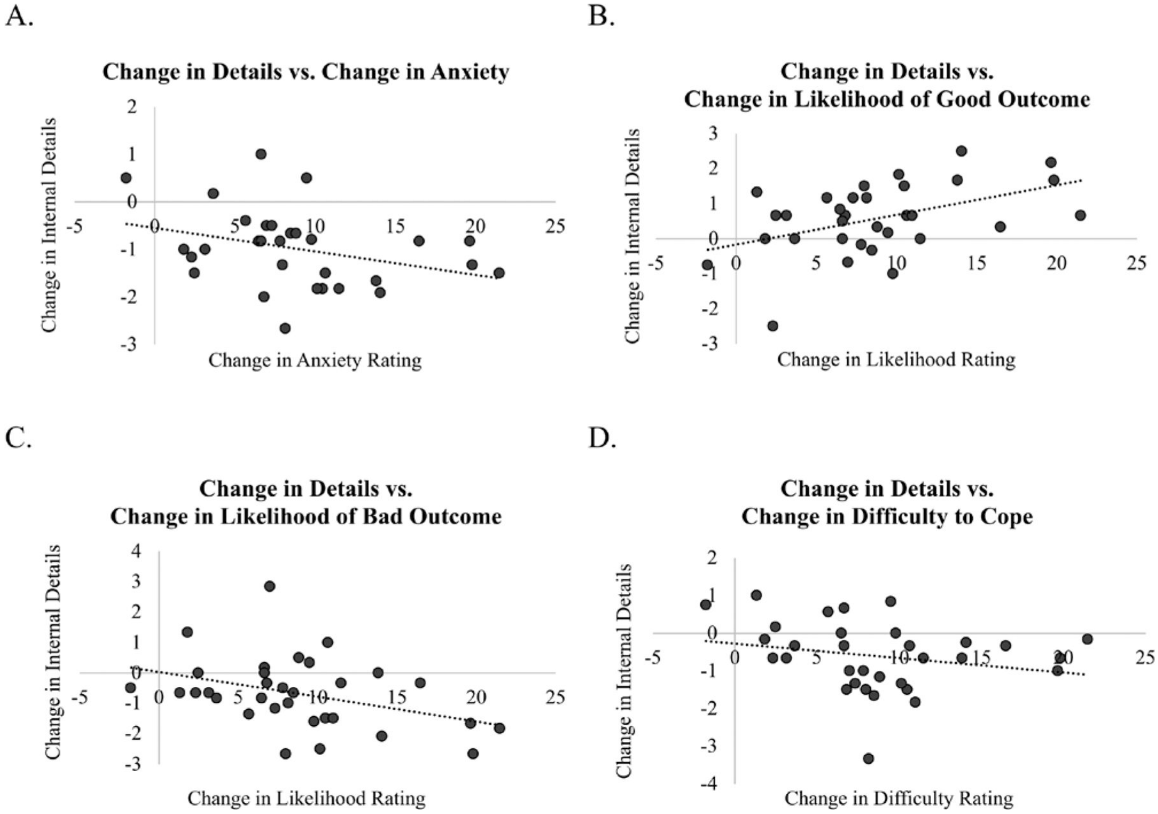

Figure 7.

Experiment 2 correlations between the average boost in internal details via modified AI scoring between personal MEPS and general advice tasks (i.e., internal details in personal MEPS task – internal details in general advice task) and average decreases between personal MEPS and general advice tasks (i.e., rating after personal MEPS task – rating after general advice task) of: (A) anxiety; (B) perceived likelihood of a good outcome; (C) perceived likelihood of a bad outcome; and (D) perceived difficulty to cope with a bad outcome.