

UPWARD AND ONWARD: DIRECTION OF COUNTERFACTUALS,
FUTURE ACTION, AND WELL-BEING OVER TIME

BY

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DISSERTATION

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Abstract

Functional accounts of counterfactual thinking (Epstude & Roese, 2008) argue that upward counterfactuals make us feel bad in the short-term but maximize outcomes in the long term. The short-term relationship is well-established, but the relationship of counterfactual thinking to behavior, affect and well-being over the long term has yet to be tested. Three experimental studies spanning different lengths of time uncovered that individuals who provided an upward counterfactual were more likely to subsequently take action to improve themselves and feel better over time about what they described, compared to those who provided downward counterfactual or factual event descriptions. Repetitive thought appears to play a role in these patterns. The findings provide new insights into the long-term adaptive value of counterfactual thinking.

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Introduction

In just about every person's life there will be times when things do not go your way. It could be something you had your heart set on but that you missed out on, or something you thought would be great that turned out to be just the opposite. Perhaps it was a great job opportunity that you just missed out on, a relationship gone awry or weight you put on that you wish you had not. Afterwards, it is natural to think about what might have been, if only you had acted differently. Such reflections on how past events or actions might have turned out differently are known as counterfactual thoughts (Byrne, 1995; Epstein & Roese, 2008). Counterfactuals come to mind on a regular basis and occur relatively automatically following the experience of life problems (Goldinger, Kleider, Azuma, & Beike, 2003). They occur for major life decisions such as buying a house or getting married or more trivial matters such as ordering at a restaurant. Such reflections can focus on how things could have turned out better (upward counterfactual) or worse (downward counterfactual) (Markman, Gavanski, Sherman, & McMullen, 1993; Roese, 1994). For example, someone who gets into a car accident could think about how the accident might have been avoided or about how the accident could have been much more horrific than it was. The direction of comparison that comes to mind can have major consequences for affect, mental health and behavior (for reviews see Epstein & Roese, 2008; Zeelenberg & Pieters, 2007).

However, counterfactual thoughts often do not just have a one-time impact. For instance, thoughts about how a past romantic relationship could have turned out better or worse might recur on a regular basis in informing behavior in future relationships. Continually reflecting on the past carries the potential for bettering our decision-making and ultimately improving our lives over time. How do the effects differ from upward versus downward counterfactuals? What

mechanisms underlie the temporal patterns? The present research seeks to answer these questions in mapping the roles different forms of counterfactual thoughts play in shaping behavior and well-being over extended periods of time.

Upward Versus Downward Counterfactuals

Much of the early work on counterfactual thinking focused on the consequences of upward versus downward counterfactuals. Downward counterfactuals were largely accepted as conferring affective benefits (Feeney, Gardiner, Johnston, Jones, & McEvoy, 2005; Medvec, Madey, and Gilovich, 1995; Roese & Olson, 1995; Sanna, 2000; Sanna, Chang, & Meier, 2001; Sanna, Meier, & Wegner, 2001). No matter how bad a given outcome might be, imagining how it could have been worse can serve as a form of consolation that, in turn, can lift your spirits. For instance, a student who gets a B- on an exam might be disappointed at first but, upon reflecting about what would have happened had he spent less time studying than he actually did, he might conclude he could easily have ended up with a C, a much more depressing result. Through this contrast effect, the status quo seems better than it might otherwise have seemed.

In contrast, upward counterfactuals were for some time thought to be a biased form of thinking that was mostly detrimental (Gavanski & Wells, 1989; Gleicher et al., 1995; Landman, 1987; Macrae, 1992; Macrae, Milne & Griffiths, 1993; Miller, Turnbull, & McFarland, 1990; Sherman & McConnell, 1995). For example, a victim of violence who thinks of all the ways she might have prevented her assault is more likely to subsequently blame herself for the outcome than a victim who does not ruminate on such upward counterfactual thoughts (Branscombe & Weir, 1992; Macrae, 1992; Macrae et al., 1993; Miller & Gunasegaram, 1990; Turley, Sanna, & Reiter, 1995). Yet, much of the time, this blame can be unwarranted and thus could be considered an impaired form of judgment that undermines effective decision-making.

The Functional Theory of Counterfactual Thinking: Promoting Behavioral Regulation

Our knowledge about counterfactuals has evolved during the past two decades. Several researchers have advanced the view that, while upward counterfactuals might make people feel bad in the short-term, their content can actually play a critical role in learning from mistakes and regulating behavior to maximize future outcomes (Epstude & Roese, 2008). For instance, the functional theory of counterfactual thinking argues that upward counterfactuals facilitate causal inferences ("if I had or had not done X, Y would have occurred") which in turn can facilitate intentions ("I will do X in the future") and positive behaviors. A number of studies have now established this link to forming intentions to do better in the future (Krishnamurthy & Sivaramann, 2002; Morris & Moore, 2000, Study 1; Page & Colby, 2003; Roese, 1994, Study 2; Smallman & Roese, 2009). Moreover, actual improvements in performance have been documented on a range of tasks (e.g., anagrams, a flight simulator, study habits, and a course test) (Markman, McMullen, & Elizaga, 2008; Nasco & Marsh, 1999; Reichert & Slate, 2000; Roese, 1994, Study 3). By contrast, the contents of downward counterfactuals have only been *indirectly* linked to performance and positive behaviors through the induction of negative affect (e.g., when it is vividly imagined that a worse outcome actually occurred, this can serve as a "wake up call") (McMullen, 1997; Markman & McMullen, 2003; McMullen & Markman, 2000; Markman et al., 2008), perceptions of meaning (Kray et al., 2010; Galinsky, Liljenquist, Kray, & Roese, 2005), connectedness and commitment (Ersner-Herschfield, Galinsky, Kray, & King, 2010).¹ Most of the time, downward counterfactual thoughts only indicate how the status quo could be worse, but do not provide many clues for improvement beyond that. Thus, it seems that only upward counterfactuals have a direct link to behavior regulation.

¹ While Kray et al. (2010) and Ersner et al. (2010) speak of a general link between counterfactual thinking with meaning, connectedness, and commitment, the focus of both papers is almost entirely on downward counterfactuals.

Counterfactuals and Well-Being

There is also some indication that upward (and not just downward) counterfactuals can as well promote enhanced positive affect and subjective well-being. For instance, Lecci, Okum and Karoly (1994) found in a cross-sectional study that individuals who generated regrets (a form of self-focused upward counterfactual) for which they saw a measure of progress were more likely to have higher subjective well-being than those who generated other forms of regrets.² Moreover, when individuals vividly imagine that an upward counterfactual has actually occurred, rather than evaluate the contents of the counterfactual, they experience positive affect instead of negative affect (Markman et al., 2008).³

In terms of longer term patterns, in a recent two-year longitudinal study, individuals who were low in the propensity to have regrets saw no change in life satisfaction over the period examined, while those high in regret propensity saw a significant increase over the same period (Morrison & Roese, 2012).

Counterfactuals and Long-Term Betterment: Procedural Learning and Repetitive Thought

Over time, upward counterfactuals do carry the potential for continual improvements in behavior and well-being. When mistakes are made or opportunities foregone, upward counterfactuals can lead to the generation of causal inferences which facilitate procedural learning of what to do differently the next time a similar (or the same) situation arises. In turn, performance and decision-making should improve in those areas where upward counterfactuals were generated.

Another way upward counterfactuals may exert their effects over the long-term is through repetitive thought (chronic, repeated thinking about an object or events). Repetitive

² Regret was defined as goals never pursued. Therefore, only counterfactuals involving inaction were covered.

³ However, upward counterfactual reflection was less likely to be related to persistence, performance and strategic inferences than upward counterfactual evaluation.

counterfactual thoughts are more likely following the experience of negative affect and in response to difficult events (Roese et al., 2009). When such repetitive thoughts are excessively negative (referred to as rumination by some researchers, see Watkins, 2008 for a review) this is associated with depression (Ingram, 1990; Nolen-Hoeksema, 2000; Pyszczynski & Greenberg, 1987). Yet repetitive thoughts can also have their own benefits. When repetitive thoughts are constructive or positive in nature, they can be helpful in dealing with traumatic life events (Pennebaker, 1997; Tedeschi & Calhoun, 2004), promote problem-solving and facilitate behavioral planning and adaptive behaviors that reduce future threats to well-being (Davey, Hampton, Farrell, & Davidson, 1992; El Leithy, Brown, & Robbins, 2006; Tallis & Eysenck, 1994; Watkins, 2008). Thus, repetitive thought is associated with behavioral improvements in a variety of settings, but also with improved well-being (lowered levels of depression) following negative life events. In addition, in the previously mentioned two year longitudinal study (Morrison & Roese, 2012), those who had engaged in more repetitive thought regarding their regrets were more likely to have reduced regret intensity and increased positive reframing of the regretted experiences two years later. Repetitive upward counterfactual thoughts can help keep your “eyes on the prize” by ensuring that past mistakes and planned improvements are not forgotten. Repetitive thought also provides for greater reflection which can also assist in seeing bright spots where they were not seen before. Thus, when upward counterfactuals facilitate positive or constructive repetitive thoughts, this can potentially have long-term behavioral and affective benefits.

In sum, counterfactuals of different forms can influence affect and behavior through various means. However, there remains much we still do not know about their impact and the mechanisms through which they exert them, particularly over extended periods of time.

The Present Research: The Impact of Counterfactual Thoughts Over Time

Despite the wealth of research to date, there is still much to be learned about the long-term impact of counterfactual thoughts. We know that some upward counterfactual thoughts such as individual's biggest regrets can literally last a lifetime, while others fade away. However, virtually all research on counterfactual thinking has been confined to measurements at one time point or over a very short period. What has been lacking, therefore, are experimental demonstrations that upward counterfactuals confer behavioral or affective benefits over an extended period of time.⁴ This research aims to answer key questions about the long-term effects of counterfactual thoughts. For instance, if an individual thinks about how he could achieve a better social life than he currently has, would he be more socially confident weeks later than those who instead think about how their social experiences could have been worse? If a woman concerned with her weight thinks about how she might have achieved better results with her last attempt at dieting, will she achieve better results in the future and feel better about past outcomes than her peers who do not even consider how personal improvements could have been made? If counterfactuals are generated in an area of deep personal relevance, would they actually affect overall well-being and mental health over time?

The present research involves a series of studies over varying lengths of time that seek to establish what types of counterfactual thoughts (e.g., upward vs. downward) are more likely to start a chain toward improved life circumstances and affect, and when such benefits are most likely to be derived over the long-term. The studies seek to assess for the first time the links

⁴ All experimental studies in which the direction of counterfactual was manipulated were cross-sectional rather than longitudinal. While Nasco and Marsh (1999) explored the link between counterfactuals and performance in an academic course over a one month period, there was no experimental manipulation in the study. Moreover, the authors did not measure whether counterfactual thoughts about a specific test conferred benefits in other areas of performance beyond a future test in the same course. No published study exists exploring the link between counterfactual thoughts and behavior over a period of longer than a month.

between counterfactuals, intentions, behavior, and affect/well-being, and to establish how they ebb and flow together over time. Establishing the link between different types of counterfactuals, outcome maximization, and affect/well-being in the short-term versus long-term would provide new insights into the adaptive value of counterfactual thinking.

Hypotheses

Previous work on counterfactual thinking suggests several hypotheses for how different types of counterfactual thoughts will relate to affect and behavior over time:

H1. Corrective action to improve a past outcome is more likely following an upward counterfactual than a downward counterfactual or factual thought. This hypothesis would be consistent with the wealth of research showing that upward counterfactuals have direct links to behavioral improvements (Markman, McMullen, & Elizaga, 2008; Nasco & Marsh, 1999; Reichert & Slate, 2000; Roese, 1994, Study 3).

H2. Ratings of negative affect will decline more over time for individuals who generate upward counterfactuals than for individuals who generate downward counterfactuals or factual thoughts. This is because upward counterfactuals can generate other positive benefits (causal inferences, procedural learning, constructive repetitive thoughts) that allow individuals to make improvements and see silver linings where they were not seen before (e.g., “I really felt awful when I got that D when I could have got an A, but it was for the best because I learned where I went wrong and am now studying much better than before”).

H3. Participants are more likely to report higher procedural learning from upward than downward counterfactual or factual thoughts. Procedural learning concerns what to do to ensure a better result the next time a similar situation arises. It is tied to causal inferences in that such inferences are required in order to know what might have brought superior results in the past

(e.g., “if only I had not eaten so much chocolate last month, I wouldn’t have put on weight. I know now to swear off chocolate this month”).

H4. Repetitive thought ratings (how much a person tends to think about a described event) will be higher for individuals who generate upward counterfactual thoughts than for individuals who generate downward counterfactual or factual thoughts. This is in line with findings that repetitive thoughts are more likely following the experience of negative affect and negative life events (Nolen-Hoeksema, 2000; Roese et al., 2009).

H4a. Repetitive thought at each time point will predict taking corrective action at later time points and declines in negative affect. This is consistent with research demonstrating that repetitive thought has been associated with problem-solving, behavioral planning and rebounding from negative life experiences (Davey, Hampton, Farrell, & Davidson, 1992; El Leithy, Brown, & Robbins, 2006; Pennebaker, 1997; Tallis & Eysenck, 1994; Tedeschi & Calhoun, 2004; Watkins, 2008). However, it is also possible that repetitive thought will be a negative predictor of corrective action if such thoughts turn out to be largely negative and promote instead self-defeat (Ingram, 1990; Nolen-Hoeksema, 2000; Pyszczynski & Greenberg, 1987).

H5. Upward counterfactual thoughts are more likely to precede increased subjective well-being (e.g., life satisfaction) and decreased depression and anxiety over the long-term than downward counterfactual or factual thoughts. Given that upward counterfactuals should promote improved behavior and affect over time, this should lead to general life improvements. In turn, there should be a spill over into feelings of general well-being and improved mental health.

I aimed to test these hypotheses first through two short-term experimental studies, and then a more comprehensive longer term study. Each study involved randomly assigning

participants to engage in a particular event reflection (e.g., upward versus downward counterfactuals or factual thoughts) and following behavioral and affective responses to the events described over time. The first study focused on social experiences, while studies 2 and 3 focused on dieting experiences. Together the studies provide important insights into the relationship between counterfactual thinking, behavior and well-being over time.

Study 1

In the first study, I examined whether, over a two-week period, upward counterfactual thoughts about a given event were more likely to lead to corrective action and feeling better about the outcome relative to downward counterfactuals. Assuming a medium effect size ($d = .50$) and a desired power of at least .80, it was required to recruit at least 128 participants to achieve this level of power to observe differences between the two experimental groups.⁵ However, this would prove challenging to achieve.

Participants and Procedure

Fifty-two college students (32 women) participated in exchange for course credit in a two-part study with sessions that were two weeks apart (Time 1 and Time 2). All responses were collected via computer. At Time 1, participants were asked to think of an important social experience from their lives for which there was a reasonable likelihood that that the same or similar event might occur again in the future. Participants were randomly assigned to describe this event either in terms of how it could have turned out better (upward counterfactual condition) or how it could have turned out worse (downward counterfactual condition). The instructions were as follows:

Please describe in as much detail as possible an IMPORTANT SOCIAL EXPERIENCE that you WISH HAD TURNED OUT BETTER (*COULD HAVE TURNED OUT WORSE*) than it actually did and for which a SIMILAR SITUATION COULD HAPPEN IN THE FUTURE.

In your description please focus specifically on WHAT YOU COULD HAVE DONE OR NOT DONE that would have led the event to turn out BETTER (*WORSE*). As well, provide us with some details about this experience (e.g., a little bit of background, what

⁵ The statistical software G*Power was used to conduct a-priori power analyses.

you should or should not have done differently, what led up to it, who else was around, the event/circumstances that triggered it, and the ultimate outcome). Again, please make sure that you are describing a SOCIAL EXPERIENCE that you thought was IMPORTANT and that YOU WISHED HAD TURNED OUT BETTER (*COULD HAVE TURNED OUT WORSE*) THAN IT DID. Please make sure you indicate WHAT YOU COULD HAVE DONE OR NOT DONE THAT MIGHT HAVE MADE IT TURN OUT BETTER (*WORSE*).

The upward or downward counterfactual event description was in turn followed by a series of scale items relating to the event (see below). All the measures were seven-point scale items, either Likert (1 = strongly disagree, 7 = strongly agree) or bipolar (1 = one extreme, 7 = other extreme) in nature, unless otherwise noted. The measures included:

Importance. "How important was the event's outcome to you?" This variable was only measured at Time 1 and was intended as a control variable.

Behavioral Control. "I had a lot of control over the way this event turned out." This variable was only measured at Time 1 and was intended as a control variable.

Negative Affect "I feel sad whenever I think about this event."

Repetitive Thought. "How often have you thought about this event since it happened?" from 1 (not at all) to 7 (very often).

Procedural Learning. Participants were asked to rate their agreement with the statement "I learned what to do better the next time a similar situation arises".

Behavioral Intentions. Participants were asked to answer yes or no to the statement "Do you plan to take (further) action to improve the outcome of this event in the next 2 weeks?"

At Time 2 (approximately two weeks later), participants were reminded of the event they described at Time 1. They were asked to rate the event on the same items as at Time 1, and also to indicate if they took action in the previous two weeks in relation to the event and whether such action(s) were deemed successful. In the case of repetitive thought, the question was re-worded to probe simply how often they've been thinking about, and dealing with, the event over just the previous two weeks. The design of this study allowed for preliminary tests of the major hypotheses of this research.

Results and Discussion

The analyses focused primarily on the predictors of taking corrective action and changes in negative affect over a two-week period, and the differences between upward and downward counterfactuals in these patterns. Fifty-one of fifty-two participants completed the surveys at both time points.

Behavior. Overall, 43% of participants indicated that they took some action over the previous two weeks that was related to the event they described at Time 1. All but one of these participants indicated that such action was successful. In line with previous work (Krishnamurthy & Sivaramann, 2002; Morris & Moore, 2000, Study 1; Page & Colby, 2003; Roese, 1994, Experiment 2; Smallman & Roese, 2009), intentions to take future action that were reported at Time 1 were predictive of participants reporting at Time 2 that they took relevant action over the previous two weeks ($B = .27, p = .05$).⁶ In addition, higher repetitive thought about the event at Time 1 ($B = .27, p = .04$) and Time 2 ($B = .27, p = .05$) and Time 2 ratings of procedural learning ($B = .27, p = .05$) also predicted taking corrective action.

In comparing corrective behaviors among those who generated upward versus downward counterfactuals, participants in the upward counterfactual condition were significantly more

⁶ All beta values provided are standardized.

likely to claim that they took some action over the previous two weeks that was related to the event they described at Time 1 (Upward: 59.3% vs. Downward: 25.0%, $\chi^2(1) = 6.08, p = .01$). Moreover, participants in the upward counterfactual condition were significantly more likely to report a successful/positive outcome from actions they had taken (Upward: 55.6% vs. Downward: 25.0%, $\chi^2(1) = 4.90, p = .03$). These group differences were not explained by behavioral intentions at Time 1 (Upward: 40.7% vs. Downward: 40.0%, $\chi^2(1) = 0.03, p = .95$), perceived controllability of the event (Upward: $M = 4.78, SE = .32$ vs. Downward: $M = 4.00, SE = .37, F(1,50) = 2.30, p = .13$), or how important the event was perceived to be (Upward: $M = 5.11, SE = .28$ vs. Downward: $M = 5.72, SE = .23, F(1,50) = 2.81, p = .10$). The explanation might lie in patterns of repetitive thought, as participants in the upward counterfactual condition had significantly higher repetitive thought ratings at Time 2 (Upward: $M = 2.14, SE = .24$ vs. Downward: $M = 1.54, SE = .12, F(1,49) = 4.63, p = .04$), which in turn predicted corrective action ($B = .27, p = .05$). Thus, those who generated upward counterfactuals were more likely to keep those thoughts top of mind and this pattern of repetitive thought appeared to be associated with behavioral improvements. This is consistent with the idea of repetitive thought helping to keep one's "eyes on the prize."

Affect. Next, patterns of negative affect were examined. Overall, negative affect was marginally lower at Time 2 compared to Time 1 ($M = -.41, SE = .22, t(50) = 1.85, p = .07$). In comparing participants in the upward versus downward counterfactual conditions via repeated measures ANOVA with thought type as a between subjects variable, participants in the upward counterfactual condition had a significantly lower level of negative affect at Time 2 compared to Time 1 (Difference scores: Upward: $M = -.89, SE = .30$ vs. Downward: $M = .13, SE = .30$,

interaction $F(1,49) = 5.65, p = .02$) (see Figure 1). However, this group difference was not predicted by any of variables measured.

In sum, these findings indicate that upward counterfactuals might promote improvements in behavior and affect over time. Moreover, these findings seem to indicate that repetitive counterfactual thoughts may have greater positive value than previously assumed (Roese et al., 2009). While Roese and colleagues linked the propensity for repetitive regrets to depression and anxiety, these results indicate that repetitive thought might actually promote making behavioral improvements in important areas of life. The patterns described here are more consistent with findings that repetitive thought can serve a constructive purpose. Procedural learning is related to corrective action for either upward or downward counterfactuals. However, the results of this study fall short of providing conclusive evidence of what *best* explains changes in behavior and affect over time stemming from counterfactual thoughts.

Study 2

The first study suffered from three major flaws. First, findings from two time points do not represent a true temporal trend. It is possible that, while participants who generated upward counterfactuals were more likely to take action between two time points than were those who generated downward counterfactuals, this pattern would not manifest itself again over subsequent time periods. If upward counterfactuals are truly more likely to lead to a continuous pattern of improvement, we would expect to see more corrective actions taken no matter the length of time measured or number of time points.

Secondly, there was no control group to compare against participants in the upward and downward counterfactual conditions. Therefore, I was not able to distinguish whether upward counterfactuals are more beneficial than simply thinking factually about past events. Finally, the behavioral measures used were based solely on self-reports. A second study was thus conducted that spanned a longer time period, had three time points, had a directly observable behavioral measure, and had a control group in which individuals were asked to generate a factual description of a past experience. For these purposes, it was desired to have participants focus on an experience for which behavioral results could be measured easily and unobtrusively later. Dieting seemed an ideal target as a large majority of college women engage in it (and surely think about how they could have achieved better or worse results), and their eating habits could easily be observed in the lab. Given that dieting is far more common for women than men, only women were chosen to participate in this particular study.

Assuming a medium effect size and a desired power of at least .80, it was required to recruit at least 75 participants to achieve this level of power to observe differences between the three groups across three time points. In order to achieve this level of power to observe mean

between the three groups for those variables measured at a single point in time, it would be necessary to recruit at least 159 participants. However, achieving this level of recruitment did not prove possible.

Participants and Procedure

Sixty-three college women participated in exchange for course credit or a \$15 gift card in a three-part study spanning approximately a month in total, with each time point two weeks apart. At Time 1, participants were asked to think of an important experience or set of experiences that occurred together from their lives involving dieting for which there was a reasonable likelihood that a similar event might occur again in the future.⁷ For instance, they could describe a past period in which they were dieting, what actions they took and what the results were. Participants were randomly assigned to describe this event (or set of events over a close together time period) either in terms of how they could have obtained better results (upward counterfactual condition), how they might have ended up with worse results (downward counterfactual condition) or simply the actual results obtained in a past dieting experience (factual/control condition). The instructions were as follows for the upward versus downward counterfactual conditions:

Please describe in as much detail as possible an EXPERIENCE (or set of experiences together in time) involving DIETING that YOU WISH HAD TURNED OUT BETTER (*COULD HAVE TURNED OUT WORSE*) than it actually did and for which a SIMILAR SITUATION COULD HAPPEN IN THE NEAR FUTURE. This should also be an experience that you considered IMPORTANT.

In your description please focus specifically on what you COULD HAVE DONE OR NOT DONE that might have lead the experience(s) to HAVE TURNED OUT BETTER

⁷ Only participants who indicated they had dieted before were able to participate in this particular study.

(*WORSE*). As well, please provide us with some details about this event (e.g., a little bit of background, what you should or should not have done differently, what led up to it, who else was around, the event/circumstances that triggered this regret, and the outcome of the event/circumstances that led to your regret, etc.) with a specific focus on how the event could have **TURNED OUT BETTER** (*WORSE*). Again, please make sure that you are describing an **IMPORTANT** experience (or of experiences together in time) involving **DIETING** that **YOU WISHED HAD TURNED OUT BETTER THAN IT DID** and please make sure that you indicate what you could have done or not done that might have made it turn out **BETTER**.

The instructions for those in the factual condition were as follows: “Please describe an important experience or set of experiences you've had concerning **DIETING**. In your description please provide us with some details about this event(s), trying to describe them as **ACCURATELY** as possible.” The event description was in turn followed by manipulation check questions that asked participants to verify they had followed the instructions correctly (100% of participants did). The manipulation check items were in turn followed by ratings of event importance, the control they felt they had over the outcome, negative affect, repetitive thought and procedural learning (the same measures as in Study 1).

At Time 2, participants were reminded of the event they described at Time 1. They were asked to rate the event on the same items as at Time 1, and also to indicate what actions they had taken in the previous two weeks in relation to the event, whether these were deemed successful, and whether they planned to take any new actions in the subsequent two weeks between the second and third time points. As in Study 1, in the case of the repetitive thought item, the

question was re-worded to probe how they had been thinking about and dealing with the event over just the previous two weeks.

At Time 3, only one participant was run at a time. Participants answered similar questions as at Time 2; however, this time a bowl of M&Ms was placed in front of them and they were told that anyone was free to eat them. Before the study session began, a research assistant weighed the bowl of M&Ms with a digital kitchen scale, left the room after setting the participant up on the computer, and weighed the bowl of M&Ms again after the participant completed the study session and had left. The weight scale was deemed sufficiently sensitive as it is able to detect the difference in weight when a single M&M is removed from a bowl.

Results and Discussion

This design allowed for a renewed test of the same hypotheses as in Study 1, but over a longer time-frame with a different life domain and the use of an observable behavioral measure. Fifty-seven of sixty-three participants completed the surveys at all three time points.

Behavior. Overall, 41% of participants indicated that they took some action over the previous two weeks that was related to the event they described at Time 1. All but two of these participants indicated that such action was successful. As in Study 1, intentions to take future action that were reported at Time 1 were predictive of participants reporting at Time 2 that they took relevant action over the previous two weeks ($B = .34, p = .01$). In addition, having taken higher repetitive thought about the event at Time 1 ($B = .55, p < .001$) and Time 2 ($B = .44, p < .001$) and higher ratings in procedural learning at Time 2 ($B = .28, p = .03$) also predicted corrective action by Time 2. Procedural learning ratings at Time 1 were a marginally significant predictor of behavioral action by Time 2 ($B = .24, p = .07$). Similar patterns were observed for behaviors reported at Time 3 that took place between Time 2 and Time 3. 42.1% of participants

indicated they took some action between Time 2 and Time 3. All but one of these participants reported that their action was successful. Behavioral intentions at Time 2 ($B = .44, p = .001$), higher repetitive thought about the event at Time 1 ($B = .51, p < .001$), Time 2 ($B = .53, p < .001$), and Time 3 ($B = .46, p < .001$) and higher ratings in procedural learning at Time 2 ($B = .27, p = .04$) and Time 3 ($B = .31, p = .02$) all predicted taking action between Time 2 and Time 3.

In comparing corrective behaviors among those who generated upward versus downward counterfactuals or factual event descriptions, participants in the upward counterfactual condition were significantly more likely to claim they had taken some action between Time 1 and Time 2 that was related to the event they described at Time 1 (Upward: 75.0% vs. Downward: 25.0% vs. Factual: 31.6%, $\chi^2(2) = 7.48, p = .02$). The same was true for behaviors reported at Time 3 that took place between Time 2 and Time 3 (Upward: 66.7% vs. Downward: 30.0% vs. Factual: 31.6%, $\chi^2(2) = 6.52, p = .04$). These group differences were not explained by perceived controllability of the event (Upward: $M = 5.00, SE = .33$ vs. Downward: $M = 4.57, SE = .40$ vs. Factual: $M = 5.37, SE = .37, F(2,60) = 1.14, p = .33$), or how important the event was perceived to be (Upward: $M = 5.09, SE = .36$ vs. Downward: $M = 5.24, SE = .32$ vs. Factual: $M = 5.68, SE = .31, F(2,60) = .84, p = .44$). Moreover, while there was an overall difference in behavioral intentions at Time 1 (Upward: 81.0% vs. Downward: 42.9% vs. Factual: 57.9%, $\chi^2(2) = 6.47, p = .04$) and Time 2 (Upward: 77.3% vs. Downward: 25.0% vs. Factual: 47.4%, $\chi^2(2) = 11.47, p = .003$), when comparing only those in the upward counterfactual and factual conditions, the differences were not significant at Time 1, $\chi^2(1) = 2.53, p = .11$.

However, as in Study 1, group differences in corrective action might be explained by patterns of repetitive thought. Participants in the upward counterfactual condition had

significantly higher repetitive thought ratings than participants in both downward and factual conditions at Time 2 (Upward: $M = 3.50$, $SE = .38$ vs. Downward: $M = 1.95$, $SE = .36$ vs. Factual: $M = 2.16$, $SE = .38$, $F(2,58) = 5.26$, $p < .01$) and Time 3 (Upward: $M = 4.11$, $SE = .48$ vs. Downward: $M = 2.05$, $SE = .29$ vs. Factual: $M = 2.32$, $SE = .43$, $F(2,54) = 7.46$, $p = .001$). As noted earlier, these measures of repetitive thought predicted corrective action between Time 1 and Time 2 and between Time 2 and Time 3.

With respect to the measure of adaptive behavior taken at the final time point, more than half (55.4%) the participants ate at least one M&M. The average weight of the M&Ms eaten was 24.5 grams ($SE = 7.77$). Individuals were less likely to eat any M&Ms if they had higher repetitive thought ratings at Time 1 ($B = -.53$, $p < .001$), Time 2 ($B = -.33$, $p = .01$) and Time 3 ($B = -.31$, $p = .02$). Individuals ate fewer M&Ms overall if they had higher repetitive thought ratings at Time 1 ($B = -.35$, $p = .01$). Repetitive thought ratings given at Time 2 ($B = -.25$, $p = .07$) and Time 3 ($B = -.26$, $p = .06$) were also marginally significant predictors of eating fewer M&Ms. In comparing participants in the different conditions, individuals in the upward counterfactual condition were significantly less likely to eat any M&Ms at the final time point than were those in the other two conditions (Upward: 76.5% vs. Downward: 35.0% Vs. Factual: 26.3%, $\chi^2(2) = 10.03$, $p < .01$).⁸ However, while the trend was in the predicted direction, there were no group differences in the overall amount of M&Ms eaten by participants (Upward: $M = 6.35$ g, $SE = 3.30$ vs. Downward: $M = 37.5$ g, $SE = 17.0$ vs. Factual: $M = 27.7$ g, $SE = 8.1$, $F(2,52) = 1.89$, $p = .16$).

⁸ Using a Poisson distribution for analyses, a similarly significant effect of condition was found, $\chi^2(2) = 6.22$, $p = .04$.

Affect. Next, patterns of negative affect were examined. To analyze changes over the three time periods, multilevel modelling was employed using SAS Proc Mixed.⁹ Using this procedure, measures obtained at each time point are nested within subjects and time was inputted as a predictor of negative affect on its own as well with other predictors and the interaction of time with these predictors. Overall, negative affect ($B = -.18, p = .01$) declined significantly over time from Time 1 to Time 3. Individuals who had higher levels of repetitive thought saw a greater decline in negative affect over time (interaction $B = -.16, p = .02$). A comparison of participants in the three conditions found that those in the upward counterfactual condition saw a greater decline over time in negative affect than those in the downward counterfactual (interaction $B = -.34, p < .001$) and factual conditions (interaction $B = -.25, p = .007$) (see Figure 2). Aside from the aforementioned differences in repetitive thought ratings, there was no other variable that helped explain the group difference.

In sum, the results indicate that upward counterfactual thinking is more likely to lead to more corrective behaviors, more event relevant adaptive behavior (e.g., healthier eating in response to thinking about dieting), and better feelings about outcomes over time. Repetitive thought appears to play an important role in each of these patterns. However, it is unclear why it might be involved and what sort of content is driving the effects. Procedural learning derived from the events described do not appear to explain the group differences observed.

⁹ Using SAS Proc Mixed to measure effects over time was not as practical for analyzing the behavioral measures, as the self-reported corrective actions taken was only given at two points and the M&M's measure was only taken at one time point.

Study 3

The first two studies provided preliminary support for several hypotheses; however, more rigorous tests are required. First, neither study spanned more than one month in time, thus not allowing a significant test of long-term patterns. Secondly, the role of repetitive thought was not sufficiently examined. What kinds of repetitive thought are associated with corrective behavior and improved affect and well-being? Is it just thinking about the event in general that is helpful, or merely when the repetitive thoughts are purely constructive? In addition, hypotheses pertaining to the long-term relationship between counterfactual thought type, subjective well-being and mental health have not yet been tested. Therefore, a much more comprehensive study was warranted to provide more informed answers to the questions this research seeks to answer. Assuming a medium effect size and a desired power of at least .80, it was required to recruit at least 75 participants to achieve this level of power to observe differences between the three groups across three time points. To achieve this level of power to observe differences between the three groups for those variables measured at a single point in time, it would be necessary to recruit 159 participants. However, while the former level of recruitment was achieved (and most variables were measured at 3 points in time), the latter level of recruitment did not prove possible.

Participants and Procedure

Seventy-seven women (44 college students, 33 university employees) participated in a three-part study in exchange for a \$15 gift card. The study covered a period of three months and limited participants to actively dieting females who sought to maintain or lose weight. There were three sessions (Time 1, Time 2 and Time 3) spaced approximately a month apart. Each month, the participants were asked to reflect on their dieting progress over the previous month.

Like study 2, there were three conditions - upward counterfactual, downward counterfactual, and factual thought type. In the case of this study, those in the upward counterfactual condition were asked every month at the beginning of each study session to describe how their recent dieting could have turned out better; those in the downward counterfactual condition were always asked to reflect on how things could have been worse; and those in the factual condition were asked to describe an important experience from the past month as accurately as possible (no domain mentioned). The instructions were as follows for the upward versus downward counterfactual conditions:

Please describe in as much detail as possible how your DIETING experiences and results in the PAST MONTH could have turned out BETTER than they actually did. Try to give as many specific examples as you can think of.

In your description please focus specifically on HOW YOU PERSONALLY COULD HAVE ACHIEVED A BETTER OUTCOME? (*ENDED UP WITH A WORSE OUTCOME?*) (e.g., lost (*gained*) more weight in general or in desired areas, etc.)

Again, please make sure that you are describing your experiences over the past month involving DIETING that COULD HAVE TURNED OUT BETTER (*WORSE*) over the past month and please make sure that you are focusing what you could have done or not done that might have ACHIEVED BETTER (*ended up with WORSE*) results over this period.

The instructions in the factual condition were as follows: “Please describe a memorable experience or set of experiences you’ve had over the PAST MONTH. Please try to be as accurate as possible in your description.” The intent was to not have the factual/control participants assess their dieting behavior and focus instead on unrelated behavior at the beginning of the session.

The description of dieting experiences (in the case of the upward and downward counterfactual conditions) or factual event over the past month was in turn followed by manipulation check questions that asked participants to verify that they had followed the instructions correctly (100% of participants did). The manipulation check items were in turn followed by a series of questions related to participants' dieting experiences and future plans. Unless otherwise noted, each of the following scale and open-ended measures was given at each of the three study time points and the scale items were either Likert (1 = strongly disagree, 7 = strongly agree) or bipolar (1 = one extreme, 7 = other extreme) in nature.

Dieting and Exercise Measures

Importance. "How important is your success at dieting to you?"

Behavioral Control. "I had a lot of control over the way my dieting turned out over the past month."

Negative Affect "I feel sad whenever I think about how my dieting has gone over the past month."

Repetitive Thought. To measure general repetitive thought, participants rated on a seven point scale "How often have you thought about your dieting in general over the past month?" from 1 (not at all) to 7 (very often). Participants also answered more specific questions to separate out constructive/positive repetitive thoughts from negative thoughts. For instance, items included "in the past month, how often have you thought about the positive aspects of how your dieting has been going (e.g., the ways you have benefited from your experiences)?", "in the past month, how often have you thought the negative aspects of how your dieting has been going (e.g., the ways you have been harmed by your experiences)?" and "How often have you been thinking about steps you could take to improve your dieting?" Participants also indicated how

often they had been thinking about their dieting by selecting one of the following categories: more than once a day, at least once a day, at least every other day, a few times in a week, about once a week, a few times in a month, once over the past month and not at all. This variable was in turn transformed into a dichotomous variable of those who have thought about dieting at least once a day (coded as 1) and all others (coded as 0).¹⁰

Procedural Learning. Participants were asked to rate their agreement with the statement “Over the past month, I have learned what to do to achieve better dieting results going forward”.

Behavioral Intentions. Participants were asked to rate their agreement with the statement “I am determined to achieve better dieting results over the next month.”

Exercise Behavior. As all the participants in this study intended to maintain their current weight or lose weight, exercise would be another means through which they could help meet this goal in addition to maintaining a healthy diet. Participants were asked to answer yes or no to the question “During the PAST MONTH, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, walking for exercise, etc.?” and to indicate how many times per week they engaged in physical activity.

Dieting Behavior. Participants indicated their level of agreement with the statement “Overall, I have maintained a healthy diet over the past month”. In order to get a more detailed response of their actual eating patterns, they were asked to complete an open-ended item: “Over the past month, what have you eaten in a TYPICAL day? Please give as much detail as possible of ALL snacks, meals and other food and drinks consumed in a typical day (e.g., in describing a sandwich describe what condiments and toppings).” The response given to this item was in turn coded for number of calories by independent raters. The raters made use of the online “Food and

¹⁰ The creation of this variable was moved by the finding that over 70% of the participants in this study selected that they either thought about dieting more than once a day or at least once a day.

Fitness Journal” at everydayhealth.com, which allowed them to input each food listed in participants’ responses and total up the number of calories for a typical day. Interrater reliability was satisfactory ($r_{T1} = .85$, $r_{T2} = .60$, $r_{T3} = .80$). The author resolved discrepancies.

Mental Health and Individual Difference Measures

In addition, in order to assess the link between counterfactual thoughts and more broad measures of well-being, participants completed the following measures of well-being and mental health:

Subjective Well-Being. Subjective well-being ($\alpha_{T1} = .91$, $\alpha_{T2} = .90$, $\alpha_{T3} = .90$) was measured at each time point with Pavot and Diener’s (1993) satisfaction with life scale (SWLS). This 5-item scale asks individuals to indicate their agreement with such statements as “In most ways my life is close to my ideal,” “The conditions of my life are excellent,” and “If I could live my life over, I would change almost nothing.”

Depression and Anxiety. Participants completed the depression (distress) and anxiety scales of Mini Mood and Anxiety Questionnaire (MASQ) (Casillas & Clark, 2000). The two scales together total 18 items. This scale requests participants to rate how often they have been experiencing a range of feelings, sensations, problems, and experiences on a scale from 1 (not at all) to 5 (extremely). Examples of depression items ($\alpha_{T1} = .89$, $\alpha_{T2} = .84$, $\alpha_{T3} = .86$) include “felt like a failure“, “felt uneasy”, “felt discouraged” and anxiety items ($\alpha_{T1} = .72$, $\alpha_{T2} = .87$, $\alpha_{T3} = .87$) include “was short of breath”, “hands were shaky” and “muscles twitched or trembled”. For active dieters, it is possible that their dieting results are linked to their sense of subjective well-being and mental health. If upward counterfactuals do indeed promote long-term betterment, then they should be associated with improved subjective well-being and decreased depression and anxiety over time.

Conscientiousness. Participants also completed an individual difference measure of conscientiousness (at the first time point only) to serve as a control variable. As more conscientious people might be more likely to engage in more effective dieting, it was thus desired to control for this. Participants completed the 9 item conscientious scale from the Big Five Inventory (BFI; Benet-Martinez & John, 1998; John, Donahue, & Kentle, 1991; John, Naumann, & Soto, 2008) ($\alpha = .87$). For this measure, participants were asked to state their level of agreement with a series of statements about themselves. Examples of items included: “I am someone who does a thorough job”, “I am someone who does things efficiently” and “I am a reliable worker”)

All of the items above (except the measure of conscientiousness) were completed at each of the three time points with the same instructions each time. However, at the third and final time point, the study also included three non self-reported behavioral measures. First, the same procedure employed to observe the amount of M&Ms eaten at the final session was used again. Secondly, given that final session of the study took place on the second floor of the Psychology building at the University of Illinois, a research assistant observed whether each participant used the stairs or the elevator to leave the final session. Thirdly, in order to have a more objective measure of participants’ actual dieting results, all of them had their weight taken on a scale after the first and final time points. In order to avoid creating an undue effect on participants’ responses, the scale was kept in another room so that participants were not thinking about it while they were giving their responses. While the fact that they would be asked to be weighed was mentioned in the consent form, participants were not directly told by the research assistant that their weight would be taken until they had completed all their responses for the session.

I predicted that those in the upward counterfactual condition would be less likely to eat M&Ms and more likely to take the stairs from the last study session and that they would lose the most weight over the study period.

This study allowed for an in depth test of how counterfactual thinking can influence behavior, affect and well-being over a longer period than the previous two studies. Moreover, the study allowed for a clarification of the role of repetitive thought in potentially facilitating the translation of upward counterfactual thoughts into positive results. In addition, this design helped to establish the relationship between different types of counterfactual thinking (via manipulated thought type) and global measures of subjective well-being and mental health.

Results and Discussion

This design allowed for a test of each of the main hypotheses of this research. Seventy-one of seventy-seven participants completed the surveys at all three time points. For all measures that were collected at all three time points, multilevel modelling was employed using SAS Proc Mixed in order to analyze changes over time. As noted earlier, in using this procedure measures obtained at each time point are nested within subjects and time is inputted as a predictor along with other predictors to assess interaction effects. In cases where the measure was only administered twice (e.g., obtaining participants' weight), predictors of change were analyzed via repeated measures ANOVA with nominal predictors entered as between subjects factors and continuous predictors entered as covariates. The measure of conscientiousness was used as a control variable throughout the analyses (the responses to the conscientious measure collected at Time 1 were assumed to remain constant across time).^{11 12}

¹¹ Conscientiousness was a positive predictive across time points of positive repetitive thought ($B = .30, p < .001$), repetitive thought regarding steps for improvements ($B = .23, p = .003$) and procedural learning ($B = .25, p < .001$) and a negative predictor of negative affect ($B = -.14, p < .05$) and anxiety ($B = -.20, p = .01$); however, conscientiousness was not related to any of the behavioral measures (all $ps > .23$).

Exercise Behavior. The key measures of exercise behavior were engaging in physical activity over the previous month and the frequency of physical activity (in times per week). Overall, participants were extremely likely to report they had engaged in some type of physical activity over the previous month (T1: 94%; T2: 89%; T3: 89%). There was no measurable change over time ($B = -.08, p = .11$); however, engaging in physical activity was more likely to increase over time among those who engaged in more general repetitive thought (interaction $B = .12, p = .04$). The likelihood of having engaged in physical activity increased marginally over time among those who engaged in more positive repetitive thought (interaction $B = .10, p = .07$). Across time points, general repetitive thought ($B = .21, p = .002$), positive repetitive thought ($B = .15, p = .04$) and repetitive thought specifically about steps to improve one's dieting ($B = .20, p = .003$) all predicted engaging in physical activity, but negative repetitive thought did not ($B = .09, p = .21$). In looking more closely at the amount of repetitive thought, participants who thought about their dieting at least once a day (who comprised 72.4% of the sample) were significantly more likely to have engaged in some type of physical activity over the previous month than those who thought about their dieting less often ($B = .20, p = .01$). Those who felt they had maintained a healthy diet over the previous month ($B = .15, p = .03$) and those who had higher ratings of procedural learning ($B = .16, p = .03$) were also more likely to have engaged in some form of physical activity.

Regarding the number of times participants engaged in physical activity per week, there was no change over time (T1: $M = 4.34, SE = .45$; T2: $M = 4.94, SE = .86$; T3: $M = 4.79, SE = .87$) ($B = .02, p = .57$); however, individuals who engaged in more positive repetitive thought

¹² As the results were not measurably changed by including conscientiousness as a control variable, the results that follow are without conscientiousness included in the models. All results that follow that utilized PROC mixed include time, a single predictor and the interaction of time with that predictor unless otherwise specified.

were more likely to increase their physical activity per week over the period of the study (interaction $B = .12, p = .04$). There were no other variables that predicted variations in physical activity per week.

In comparing physical activity levels among those who generated upward versus downward counterfactuals and factual event descriptions, there were no significant differences (all $ps > .19$). Moreover, unlike in Studies 1 and 2, there were no group differences in general repetitive thought at any time points (all $ps > .62$) (see Table 1), though general repetitive thought continued to be predictive of behavior overall. There were also no group differences in any of the subtypes of repetitive thought (e.g., negative, positive, focus on improvements that can be made).

However, the failure to find group differences in physical activity and repetitive thought is perhaps due to ceiling effects. Rates of physical activity and repetitive thought were quite high at the beginning of the study for participants in all conditions. In the case of repetitive thought, the ratings were dramatically higher across participants than in the previous two studies.

Dieting Behavior. The key measures of dieting behavior were self-reported quality of dieting over the previous month, calories consumed on a typical day, weight loss over the period of the study (from Time1 to Time 3), eating M&M's at the final study session (Time 3) and whether the stairs were used instead of the elevator at the final session. Overall, there was no change over time in participants' perceptions of the quality of their dieting (T1: $M = 4.69, SE = .18$; T2: $M = 4.94, SE = .19$; T3: $M = 4.69, SE = .22$) ($B = .001, p = .99$). However, individuals who thought about their dieting at least once a day (interaction $B = .12, p = .03$) were more likely to perceive improvements in their diet over time. Across time points, general repetitive thought ($B = .25, p = .003$), positive repetitive thought ($B = .30, p < .001$) and procedural

learning ($B = .25, p = .003$) were positive predictors of perceived quality of diet while negative repetitive thought was a negative predictor ($B = -.33, p < .001$).

In comparing participants in the different conditions, those who provided upward counterfactuals were more likely to perceive greater improvements in their diet over time than those who provided downward counterfactuals (interaction $B = .14, p = .03$). A similar but smaller (marginal) difference over time was observed in comparing participants in the upward counterfactual condition with those in factual event condition (interaction $B = .11, p = .07$) (see Table 1). Participants who provided upward counterfactuals were also more likely to report a higher quality diet across all time points when compared to those who provided a factual event description ($B = .27, p = .02$).

In looking at calories consumed on a typical day, there was a decline over time across the whole sample (T1: $M = 1438.7, SE = 77.8$; T2: $M = 1329.1, SE = 49.8$; T3: $M = 1237.6, SE = 61.6$) ($B = -.17, p = .004$). Across time points, calories consumed were more likely to be lower among those who engaged in more positive repetitive thought ($B = -.15, p = .04$). In comparing the experimental groups, upward counterfactual participants were more likely to see a significant decline in calories consumed over time compared to the factual group participants (interaction $B = -.22, p = .008$). However, the upward counterfactual and downward counterfactual participants exhibited similar levels of decline over time (interaction $B = -.08, p = .21$) (see Table 1).

Another key behavioral variable was weight lost (in lbs. and as a percentage of original weight at Time 1). Overall, participants did lose weight over the period of the study ($M = 1.93$ lbs., $SE = .71$), $t(66) = 2.73, p = .008$. Time 3 ratings of the quality of diet over the previous month ($B = .26, p = .03$) were predictive of the amount of weight lost. In comparing participants in the different conditions, repeated measures ANOVA procedures revealed that individuals in

the upward counterfactual condition lost significantly more weight than those in the downward counterfactual and factual conditions (Upward: $M = 4.62$ lbs., $SE = 1.60$ vs. Downward: $M = .86$ lbs., $SE = .85$ vs. Factual: $M = -.12$ lbs., $SE = .54$ interaction $F(1,46) = 4.28$, $p = .04$ and interaction $F(1,41) = 6.42$, $p = .02$, respectively) (see Figure 4). Similar differences were observed when looking at percentage of weight lost (Upward: $M = 2.46\%$, $SE = .79$ vs. Downward: $M = .50\%$, $SE = .50$ vs. Factual: $M = .02\%$, $SE = .40$, $F(1,46) = 4.30$, $p = .04$ and $F(1,41) = 6.49$, $p = .02$, respectively).

Another measure of behavior was observing whether participants would eat M&Ms at the Time 3 study session and how much they would eat. The average weight of the M&Ms eaten was 5.59 grams ($SE = 1.65$). In comparing participants in the different conditions, there were no significant differences in the amount of M&Ms eaten (Upward: $M = 9.80$ g, $SE = 4.09$ vs. Downward: $M = 1.88$, $SE = .80$ vs. Factual: $M = 4.81$ g, $SE = 2.18$, $F(2,67) = 2.13$, $p = .13$) or in the percentage of participants who did not eat M&Ms at the Time 3 session (Upward: 68.0% vs. Downward: 70.8% vs. Factual: 66.7%, $\chi^2(2) = .10$, $p = .95$). It is notable that the percentage for the upward counterfactual group was similar to what was observed in Study 2, but was much higher for the other groups. It is possible there may have been strong demand characteristics at play as all participants were aware that this was a study about dieting among active dieters. This could have led to improved behavior at the final session beyond what might have otherwise occurred.

The final measure of behavior was observing whether participants took stairs or an elevator to leave the Time 3 session. There were no significant differences in the percentage of participants who took the stairs over the elevator (Upward: 58.3% vs. Downward: 52.4% vs. Factual: 71.4%, $\chi^2(2) = 1.68$, $p = .43$).

In sum, upward counterfactual thinking was predictive of various (but not all) improvements in dieting behavior, but not of any of the measures of exercise behavior. Repetitive thought (in particular positive repetitive thought and thoughts focused on making future improvements) was linked to some measures of exercise and dieting, but there were no significant differences between experimental groups in repetitive thought.

Affect. Next, patterns of negative affect were examined. Overall, negative affect (interaction $B = .08, p = .14$) did not change measurably from Time 1 to Time 3. A comparison of participants in the three conditions found that those in the upward counterfactual condition saw a greater decline over time in negative affect than those in the downward counterfactual (interaction $B = -.21, p = .003$) and factual conditions (interaction $B = -.17, p = .02$) (see Figure 5). There were no other variables that predicted declines over time in negative affect. However, participants who lost more weight over the course of the study did have lower levels of negative affect at Time 3 ($B = -.35, p = .004$). Thus, there was at least a modest link between behavioral outcomes and affective experiences.

Subjective Well-Being. Overall, life satisfaction was stable over time (T1: $M = 4.85, SE = .16$; T2: $M = 4.94, SE = .17$; T3: $M = 5.03, SE = .17$) ($B = .06, p = .10$). The only variable that was associated with subjective well-being was negative repetitive thought which was a negative predictor across time points ($B = -.13, p = .02$). This is consistent with prior findings regarding negative repetitive thought (see Watkins, 2008 for a review) and provides a measure a validation for the repetitive thought measures that were used in this study. There were no group differences in subjective well-being (all $ps > .11$).

Depression. Overall, levels of depression declined significantly over time (T1: $M = 2.04, SE = .10$; T2: $M = 1.89, SE = .08$; T3: $M = 1.82, SE = .08$) ($B = -.16, p = .004$). Consistent with

prior work, negative repetitive thought ($B = .15, p = .01$) positively predicted depression across time points while positive repetitive thought was an inverse predictor ($B = -.15, p = .02$). There were no group differences (all $ps > .61$).

Anxiety. Overall, levels of anxiety declined significantly over time (T1: $M = 1.43, SE = .06$; T2: $M = 1.42, SE = .08$; T3: $M = 1.40, SE = .06$) ($B = -.04, p = .41$). Anxiety was more likely to decrease over time among those who consumed fewer calories on a typical day (interaction $B = -.09, p = .03$). Across time points, negative repetitive thought ($B = .19, p = .001$) predicted anxiety, while positive repetitive thought was an inverse predictor ($B = -.24, p < .001$). There were no group differences (all $ps > .49$).

In sum, the analyses of patterns of negative affect, well-being and mental health found that, while upward counterfactuals were predictive of declines in negative affect, there was no relationship to broader measures of well-being.

General Discussion

Thinking about how our past life experiences could have gone better is something we all do regularly. Yet, while engaging in upward counterfactual thinking can often feel bad, it carries the potential to teach valuable lessons and the pain experienced from them can serve as a motivator to take corrective action. Upward counterfactuals have been shown in the laboratory to confer positive insights and improvements in performance on a variety of momentary tasks (Krishnamurthy & Sivaramann, 2002; Markman, McMullen, & Elizaga, 2008; Morris & Moore, 2000, Study 1; Page & Colby, 2003; Reichert & Slate, 2000; Roese, 1994; Smallman & Roese, 2009). However, are the positive benefits of upward counterfactuals fleeting or long-lasting? The long-term impact of counterfactual thoughts has to date remained largely unexplored, leaving many key questions unanswered. Just when are counterfactuals likely to be most beneficial? What are the temporal patterns of the relationship of counterfactual thinking to behavior and well-being and what are the mechanisms underlying these patterns? The present research sought to provide answers to these questions.

In the present research, three experimental temporal studies of varying lengths have been conducted that indicate that upward counterfactuals are more likely than downward counterfactuals and factual thoughts to lead to corrective action, showing improvements in affect and engagement in event relevant adaptive behavior (e.g., eating less unhealthy foods after answering questions about a dieting experience). In the final study, upward counterfactuals were linked to a clear improvement in behavior as active dieters who generated upward counterfactuals lost significantly more weight over the period of study than those who generated downward counterfactuals or factual thoughts. The studies also point to a potential key role that repetitive thought might play in facilitating behavioral improvements. The results greatly further

our understanding of the long-term relationship between counterfactuals, behavior and well-being.

Counterfactuals and Behavior Regulation

The present research provides strong support for the functional theory of counterfactual thinking (Epstude & Roese, 2008). According to this theory, upward counterfactuals play a key role in behavior regulation and performance improvement. However, the support for this theory to date has come almost entirely from lab studies that have demonstrated only momentary effects on intentions and behavior (Krishnamurthy & Sivaramann, 2002; Markman, McMullen, & Elizaga, 2008; Morris & Moore, 2000, Study 1; Page & Colby, 2003; Reichert & Slate, 2000; Roese, 1994; Smallman & Roese, 2009). These studies clearly demonstrated that upward counterfactuals can facilitate positive impacts on behavior in the short-term, but they did not explore whether these effects were long-lasting. Prior to the present research, there had been no experimental studies demonstrating that upward counterfactuals confer behavioral benefits over an extended period of time. The three studies I have conducted provide the first evidence that upward counterfactuals can indeed facilitate behavioral improvements over time. Individuals who engaged in upward counterfactual thinking were more likely to subsequently take action to improve their social lives, improve their dieting behavior, engage in event related adaptive behavior (e.g., eating fewer M&Ms at the Time 3 study session), and lose more weight over time than those who provided downward counterfactuals or factual thoughts. Many of these were not just one-time improvements between a first and second time point of a study, but continual improvements that lasted across at least three time points. The effects were seen for a two time point study as short as two weeks and as long as a three time point study that examined behavior over a three month period.

There were, however, some aspects of the functional theory of counterfactual thinking that were not supported. The theory predicts that upward counterfactual thoughts should be more likely to facilitate behavioral intentions and causal inferences (e.g., “if I had done X, Y would have occurred”) than other forms of event reflections such as downward counterfactuals and factual thoughts. Yet, by and large there were no significant differences in behavioral intentions between participants in the upward counterfactual, downward counterfactual and factual groups. It should be noted, however, that while the present research focused on behavioral intentions, other forms of intentions could have been explored. For instance, other research has focused as well on goal intentions and implementation intentions which have also been linked to behavior (Gollwitzer, 1990, 1993, 1999; Gollwitzer & Sheeran, 2006; Sherman, 1980; Webb & Sheeran, 2006). Future research may do well to investigate the connections between counterfactuals thinking and other forms of intentions.

Moreover, there were no differences between the experimental and control groups in procedural learning (learning what to do better the next time a similar situation arises), which is at least somewhat similar to causal inferences. That said, ratings of intentions and procedural learning were reasonably high for all groups in the different studies. Such findings may speak more to the value of other forms of event reflections (you can still learn from thinking about how things could have turned out worse or analyzing the factual outcomes) rather than indicating that upward counterfactuals do not facilitate intentions and procedural learning.¹³

¹³ It is also true that there is likely some overlap between causal inferences and constructive and positive repetitive thought; however, in the one study where these more specific forms of repetitive thoughts were measured, such forms of repetitive thought were not more likely to occur in the upward counterfactual group than in the other groups (though there were ceiling effects across all groups).

Even so, the findings indicate that there are likely mechanisms other than intentions and causal inferences at play in facilitating the benefits of upward counterfactual thoughts on behavior over time. One of those variables might be repetitive thought.

Repetitive Thought and Long-term Behavior Regulation

Repetitive thought, the “process of thinking attentively, repetitively or frequently about one’s self and one’s world” (Segerstrom, 2003, p. 909), has been found under different circumstances to evoke either problematic or beneficial effects (see Watkins, 2008 for a review). When they are excessively negative, repetitive thoughts are linked to depression (Ingram, 1990; Nolen-Hoeksema, 2000; Pyszczynski & Greenberg, 1987). However, when repetitive thoughts are constructive or positive in nature, they have been found to be helpful in dealing with traumatic life events (Pennebaker, 1997; Tedeschi & Calhoun, 2004) and in facilitating effective planning and adaptive behaviors (Davey, Hampton, Farrell, & Davidson, 1992; El Leithy, Brown, & Robbins, 2006; Tallis & Eysenck, 1994; Watkins, 2008). The first two studies of this research explored the role of repetitive thought in the general sense, without focus on valence, while the final study explored the positive and negative aspects of repetitive thought as well.

In all three studies, general repetitive thought was associated with a range of positive behaviors pertaining to social experiences, dieting and exercise, and there was evidence of improvements in many of these behaviors over time. In the final study, it was clarified that thinking repetitively about the more positive aspects of an event (e.g., constructive criticisms, lessons learned, what still went right) has stronger links to behavioral improvements than focusing on the negative aspects (e.g., how it reflects poorly on you as a person, how badly you did). In fact, negative repetitive thought was indeed associated with depression, consistent with prior research. The link between general and positive repetitive thought and behavior regulation could come from

the help repetitive thought contributes to keeping you focused and not forgetting what happened. If you do not think about your past often, then you may lose the lessons you could have learned.

Moreover, repetitive thought may at least partly underlie the link between counterfactuals and behavioral improvements over time. In the first two studies, participants who engaged in upward counterfactual thinking were significantly more likely to engage in repetitive thought. Thus, upward counterfactuals may promote “keeping your eyes on the prize” in terms of what needs to be done in the future more than other forms of reflection. However, it should be noted that in the third and final study there were no group differences in either general repetitive thought or any of the more specific forms of repetitive thought. This could be due though to ceiling effects from a particularly motivated group of participants (active dieters who were asked how often they were thinking about dieting). The levels of repetitive thought in all of the conditions was markedly higher than in the previous two studies, thus making it difficult to uncover any differences between them. Therefore, further study of the role of repetitive thought and its links to counterfactual thinking and behavior is warranted, with perhaps a life domain other than dieting and/or with a less devoted set of participants.

Counterfactuals and Well-Being

I also explored the links between counterfactual thinking and measures of well-being such as negative affect, life satisfaction, depression and anxiety. Considerable research has shown that upward counterfactual thoughts feel worse than downward counterfactual thoughts (Feeney, Gardiner, Johnston, Jones, & McEvoy, 2005; Medvec, Madey, and Gilovich, 1995; Roese, 1994; Roese & Olson, 1995; Roese & Olson, 1997; Sanna, 2000; Sanna, Chang, & Meier, 2001; Sanna, Meier, & Wegner, 2001). However, such studies only established the short-term relationship. The present research found in all three studies that individuals who engaged in

upward counterfactual thinking saw greater improvements in negative affect (significantly reduced levels over time) compared to participants in other groups (see Figures 1, 2 and 4). In fact, in no study were participants in the upward counterfactual condition experiencing more negative affect by the final session than participants in other conditions. Thus, the sting of thinking about what you could have (or should have) done to achieve a better outcome does not last. This is consistent with findings from a two year longitudinal study that found that regrets steadily decayed over time (Morrison & Roese, 2012).

However, while this research refines our thinking about the long-term relationship between counterfactuals and affect, there was no clear variable (except general repetitive thought in Study 2 and amount of weight lost in Study 3) that helped to explain the marked decline observed in negative affect for participants who engaged in upward counterfactual thinking. The link between weight loss and negative affect shows that there might be a link that develops over time between behavioral performance and reduced negative affect; however, given that this link was observed in only one study this requires further investigation.

Moreover, in looking at the long-term relationship between counterfactual thinking and life satisfaction, depression and anxiety, engaging in upward counterfactual thinking did not appear to be associated with any changes in these measures of well-being and mental health. That said, perhaps the time frame (a two month gap between Time 1 and Time 3) was too short to discover any relationship between upward counterfactuals and such broad measures of well-being. A longitudinal study that spanned two years found that regret propensity predicted improvements in life satisfaction over time (Morrison & Roese, 2012), yet such a relationship was not evident after three months. Moreover, depression, anxiety and life satisfaction are influenced by a multitude of factors well beyond the domain participants focused their event

reflections on. Thus, the influence of the manipulation of thought type on these broad measures may have been relatively minor simply because participants deal with so many other life experiences over the period of study. The relationship of counterfactual thoughts to negative affect and measures of well-being and mental health over time therefore awaits further research.

Limitations and Future Directions

This research represents the most in depth look at the relationship between counterfactuals, behavior and well-being over time; however, it is not without its limitations. First of all, the time frame of all three studies is still somewhat limited from a longitudinal standpoint. While the final study was able to cover a longer period than the first two, three months of behavior (with only two months between the first and last time points) might still be considered a short-term pattern. As noted, the fact that no relationship was found between upward counterfactual thinking and improvements in broader measures of well-being and mental health may simply be due to the fact that a longer time frame is needed to observe any changes. An ideal longitudinal study would follow participants for a longer period. However, such studies require greater financial resources, the recruitment of participants can be more difficult and they can be more vulnerable to attrition (attrition in each of the studies in this research was quite low).

It is also important to note that the results of the three studies focused on limited domains. While it is encouraging that similar patterns were found for social and dieting experiences, it is possible that the same patterns may not manifest themselves in other domains such as education and romance, which are among the most common focuses of counterfactual thoughts (Morrison & Roese, 2011; Morrison, Epstude, & Roese, in press). The particular participants used can also have an impact. For instance, the third study examined the same domain as Study 2 (dieting), but limited the pool of participants to active dieters as opposed to people who have simply dieted at some point

in the past (as in Study 2). Yet, the active dieters exhibited a number of ceiling effects with regard to their exercise behavior and levels of repetitive thought. Such ceiling effects in turn make it difficult to uncover group differences in thought and behavior. That individuals in the upward counterfactual condition still ended up showing more improvements in behavior in various ways than the other participants indicates that, perhaps with a different and less committed group, more differences would have been found.

Another limitation relates to demand characteristics that can arise in many social psychological experiments (Orne, 1962). Studying real life events is essential in order to track actual changes in behavior over time; however, such studies may be vulnerable to demand characteristics with regard to the repeated measurement over time. For instance, participants in the upward counterfactual condition were being asked to describe what they could have done better. Perhaps these participants assumed that it was desired for them to show greater declines in negative affect and report greater improvements in their diet over time. Such biased responding, however, would require participants to remember their exact responses from previous time points, which is somewhat unlikely. Participants in Study 3 also were aware that they would be weighed at the final session and that this weight would be compared to what they weighed at the first session. It is possible that the motivation to have appeared to lose weight might have been stronger among individuals who were specifically asked to focus on what they could be doing better in their dieting. However, given that all participants were active dieters who were randomly assigned to focus on a particular thought type (upward counterfactual, downward counterfactual or factual thoughts), it is likely that participants across all conditions were quite motivated to lose weight.

On another note, repeatedly reminding participants of the first two studies what they had written at the first study session (Time 1) at subsequent time points might have kept upward

counterfactual thoughts accessible when these thoughts might otherwise have decayed more rapidly. Nevertheless, it is important to note that behavioral measures such as eating M&Ms (Study 2) and weight lost over time (Study 3) matched with much of the self-report data. Moreover, many of the patterns observed from the self-report data were in line with theoretical predictions that would not have been known to the participants. I therefore have reasonable faith that the data reflect valid behavioral and affective changes over time.

Future research can certainly build on the studies I conducted and strive to minimize the limitations that I have outlined. As upward counterfactuals were positively linked to improvements in dieting and exercise, it would be worthwhile to conduct a longer term study exploring the links between counterfactuals and health promotion more broadly. For instance, in the present research, the focus was on people who were trying to lose weight, but it would be useful to study a more general pool of participants and trace the links of counterfactuals to staying fit and healthy in terms of engaging in positive behaviors (e.g., exercising, proper hygiene, regular visits to doctor, eating healthy foods and not just avoiding unhealthy foods, etc.) and avoiding risk behaviors (e.g., drugs, alcohol, unprotected sex, etc.). Furthermore, research along these lines can have implications for interventions designed to persuade individuals to reduce levels of risky health behaviors such as smoking.

Given the powerful role of repetitive thought uncovered in this research, it would be worthwhile to probe further just when and how repetitive thought can exert a positive or negative effect, and what might be the optimal levels. While one study of this research found that individuals who thought about their dieting at least once a day ended up with some of the best behavioral results (though it appeared that negative repetitive thought was associated with negative mental health outcomes), dieting may be a particularly unique domain where that is helpful with regard to

behavior. In another area of life that level of repetitive thought might prove ineffective or even harmful. In addition, the present research did not explore in depth the intensity, controllability and duration of repetitive thought of participants. Participants indicated how often they thought about their experiences, but did not indicate how long those thoughts lasted or how intense or intrusive or uncontrollable they felt. Future research should also investigate the role of repetitive thought duration, controllability and intensity and how these aspects of repetitive thought are linked to counterfactual thinking and behavior over time.

It would also be useful to study the links between counterfactual thinking, behavior and well-being in different domains of life such as romance and education and to examine whether similar effects apply when individuals are asked to focus on actions versus inactions. Furthermore, as upward counterfactuals were shown to be associated with declines in negative affect in three studies, but not with changes in more general measures of well-being and mental health, a longer term study would be required to probe further the broader links to well-being. This could be complemented by studies with more frequent and in depth assessments within a short time frame.

Perhaps most importantly, the present research has not arrived at a clear answer to the question of what are the mechanisms that best explain why upward counterfactuals facilitate improvements in behavior and affect over time. Future longitudinal studies should measure additional variables to arrive at a more conclusive answer.

Conclusion

When things go wrong and we reflect on how on how we could have done better this is not merely a one-time occurrence. Such thoughts can persist for months, even years. What is the long-term impact of these types of thoughts on behavior and well-being? Three studies explored this temporal relationship, and revealed that upward counterfactuals are more likely to facilitate

improvements in behavior and affect over time compared to other forms of event reflections. The studies provide strong support for the functional theory of counterfactual thinking (Epstude & Roesse, 2008) and illustrate that the negative affect initially triggered by upward counterfactuals fades with time.

Engaging in upward counterfactual thinking can be a painful, but ultimately beneficial experience. No one is immune to the experience of failure or setbacks in life. One can choose to wish them away, put them in the past or “let them go”. Alternatively, one can truly reflect on what could have been done differently that might have led to a better result. The present research illustrates that those who adopt the latter approach are not only more likely to do better next time, but feel better too.

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Tables and Figures

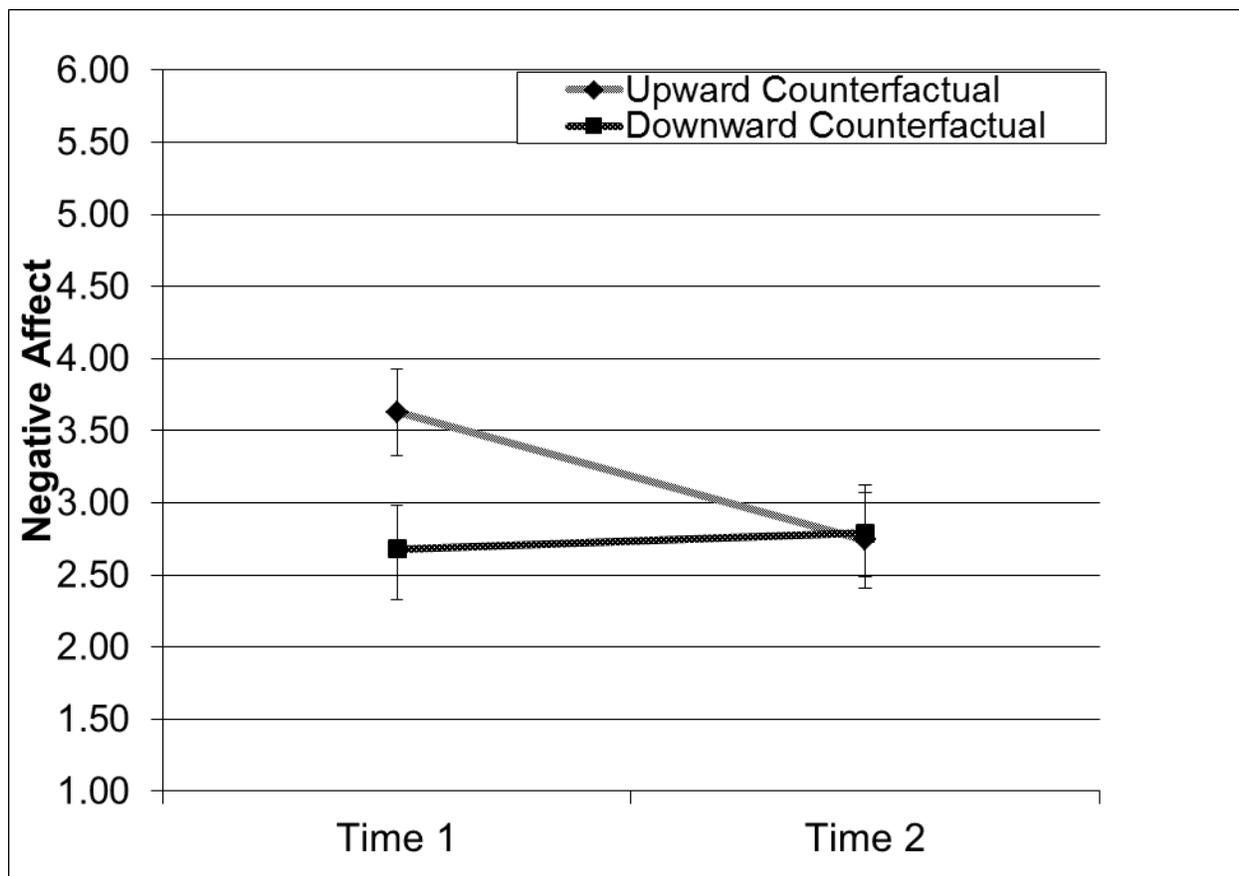
Table 1

Mean Changes Over Time by Thought Type: Repetitive Thought, Exercise and Dieting Behavior, Negative Affect, Subjective Well-Being, Depression and Anxiety (Study 3)

| Variable | Time 1 Baseline (Dieting from past month) | | | Time 2 1 Month After Baseline | | | Time 3 2 Months After Baseline | | |
|------------------------------|---|---------------------|--------------------|----------------------------------|---------------------|--------------------|-----------------------------------|---------------------|--------------------|
| | Upward (M[SE]) | Downward (M[SE]) | Factual (M[SE]) | Upward (M[SE]) | Downward (M[SE]) | Factual (M[SE]) | Upward (M[SE]) | Downward (M[SE]) | Factual (M[SE]) |
| Repetitive Thought | 5.75 (.26) | 5.90 (.28) | 6.06 (.30) | 5.79 (.27) | 6.19 (.25) | 5.78 (.32) | 5.64 (.12) | 5.62 (.31) | 5.71 (.21) |
| Physical Activities Per Week | 5.17 (1.01) | 3.67 (.52) | 4.00 (.44) | 5.75 (2.05) | 5.23 (1.05) | 3.58 (.51) | 6.25 (2.09) | 4.64 (.83) | 2.97 (.49) |
| Dieting Quality | 4.69 (.33) | 5.17 (.29) | 4.24 (.34) | 5.35 (.28) | 5.00 (.30) | 4.38 (.39) | 5.28 (.31) | 4.67 (.38) | 4.00 (.40) |
| Calories in Typical Day | 1449.7 (103) | 1544.2 (162) | 1309.6 (140) | 1298.2 (65) | 1372.2 (82) | 1318.3 (118) | 988 (96) | 1309.5 (98) | 1408(107) |
| Negative Affect | 3.46 (.35) | 2.96 (.34) | 3.62 (.41) | 3.08 (.28) | 2.75 (.36) | 3.95 (.45) | 2.76 (.36) | 4.08 (.37) | 4.43 (.39) |
| Life Satisfaction | 4.59 (.27) | 4.99 (.29) | 5.02 (.29) | 4.69 (.30) | 5.24 (.24) | 4.90 (.33) | 4.53 (.33) | 5.33 (.21) | 5.29 (.29) |
| Depression | 2.00 (.15) | 2.09 (.21) | 2.04 (.15) | 1.89 (.15) | 1.81 (.10) | 1.98 (.18) | 1.75 (.16) | 1.88 (.12) | 1.81 (.14) |
| Anxiety | 1.38 (.07) | 1.43 (.10) | 1.51 (.13) | 1.47 (.19) | 1.33 (.07) | 1.48 (.13) | 1.38 (.12) | 1.35 (.09) | 1.48 (.13) |

Figure 1

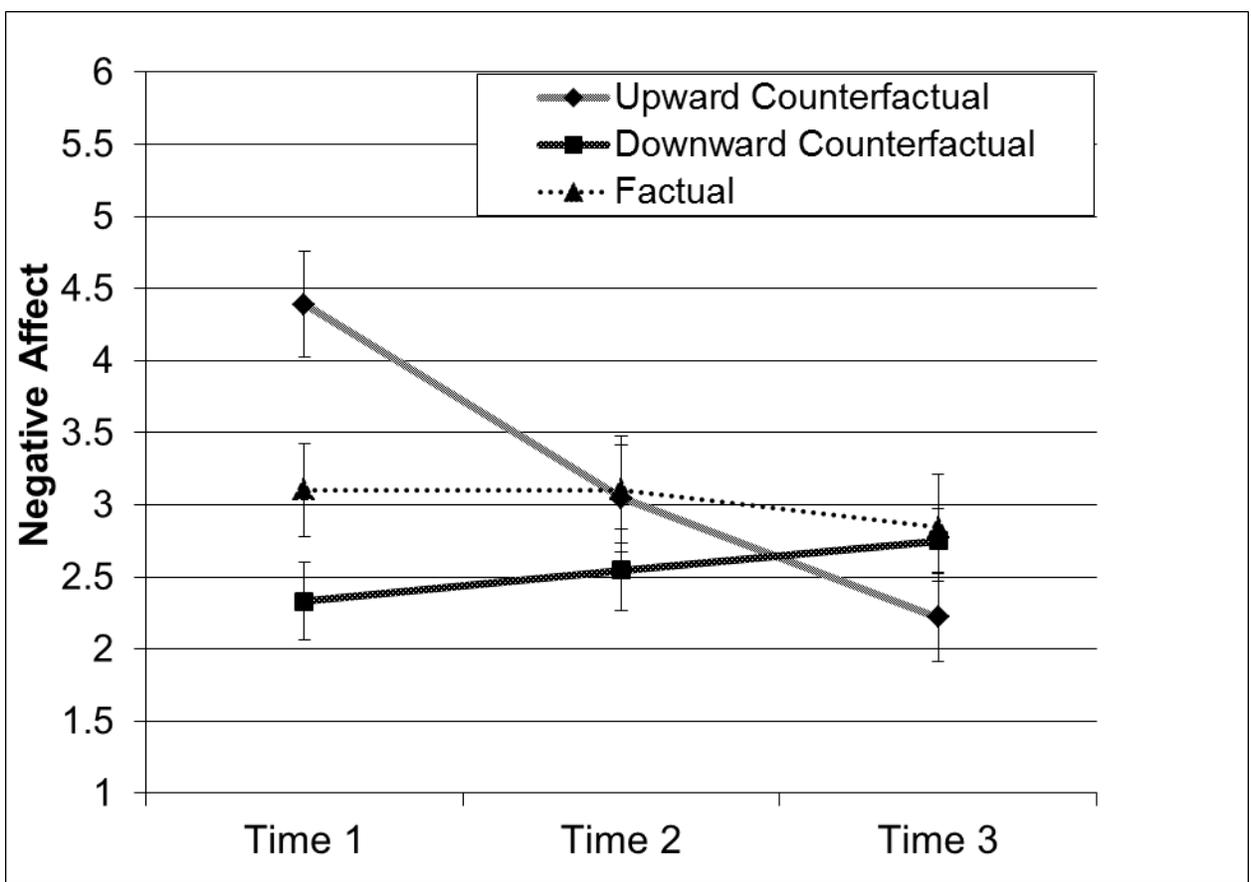
Upward Versus Downward Counterfactual Thoughts Over 2 Weeks: Negative Affect



Note. This figure displays self-reported ratings of negative affect ("I feel sad when I think about this event") over two time points that were two weeks apart.

Figure 2

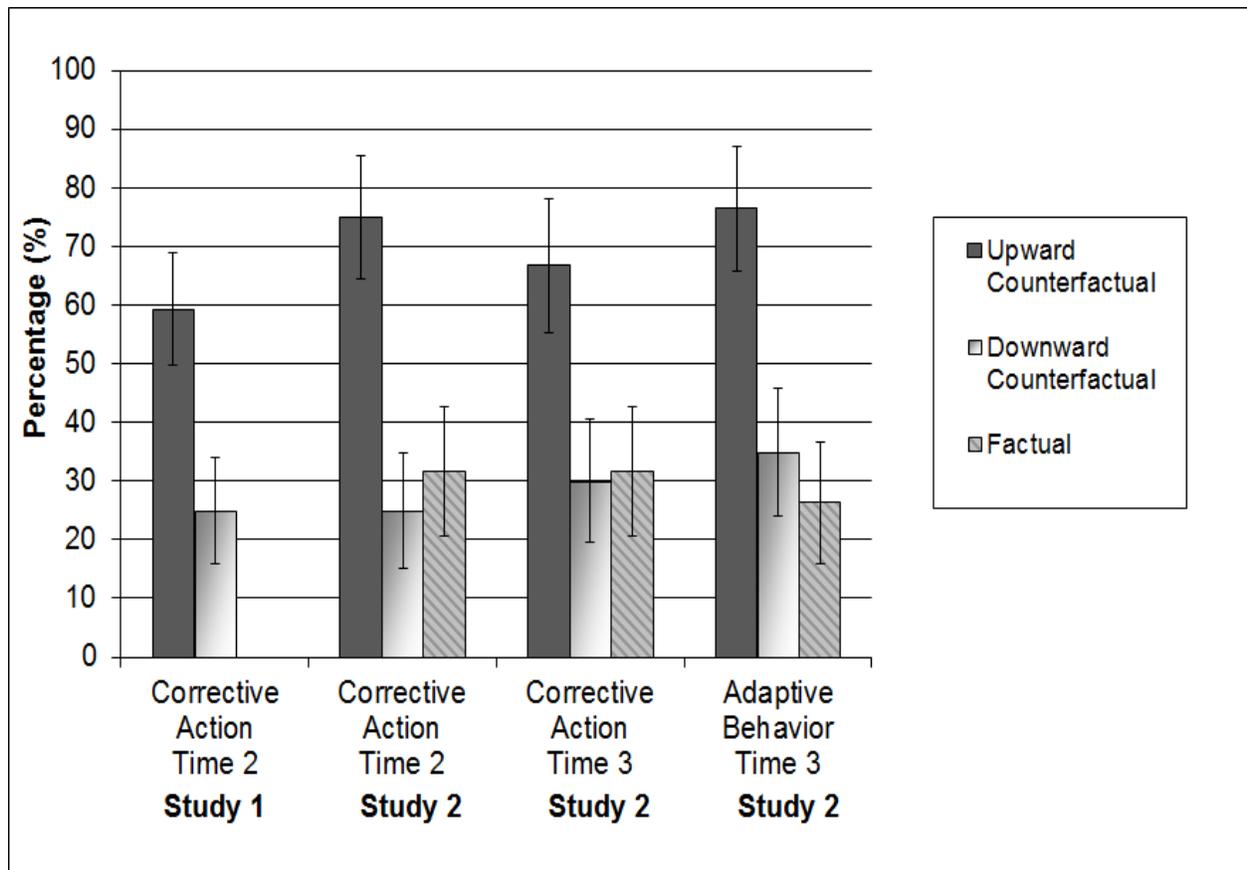
Upward Versus Downward Counterfactual and Factual Thoughts Over 4 Weeks: Negative Affect



Note. This figure displays self-reported ratings of negative affect ("I feel sad when I think about this event") over three time points that were two weeks apart.

Figure 3

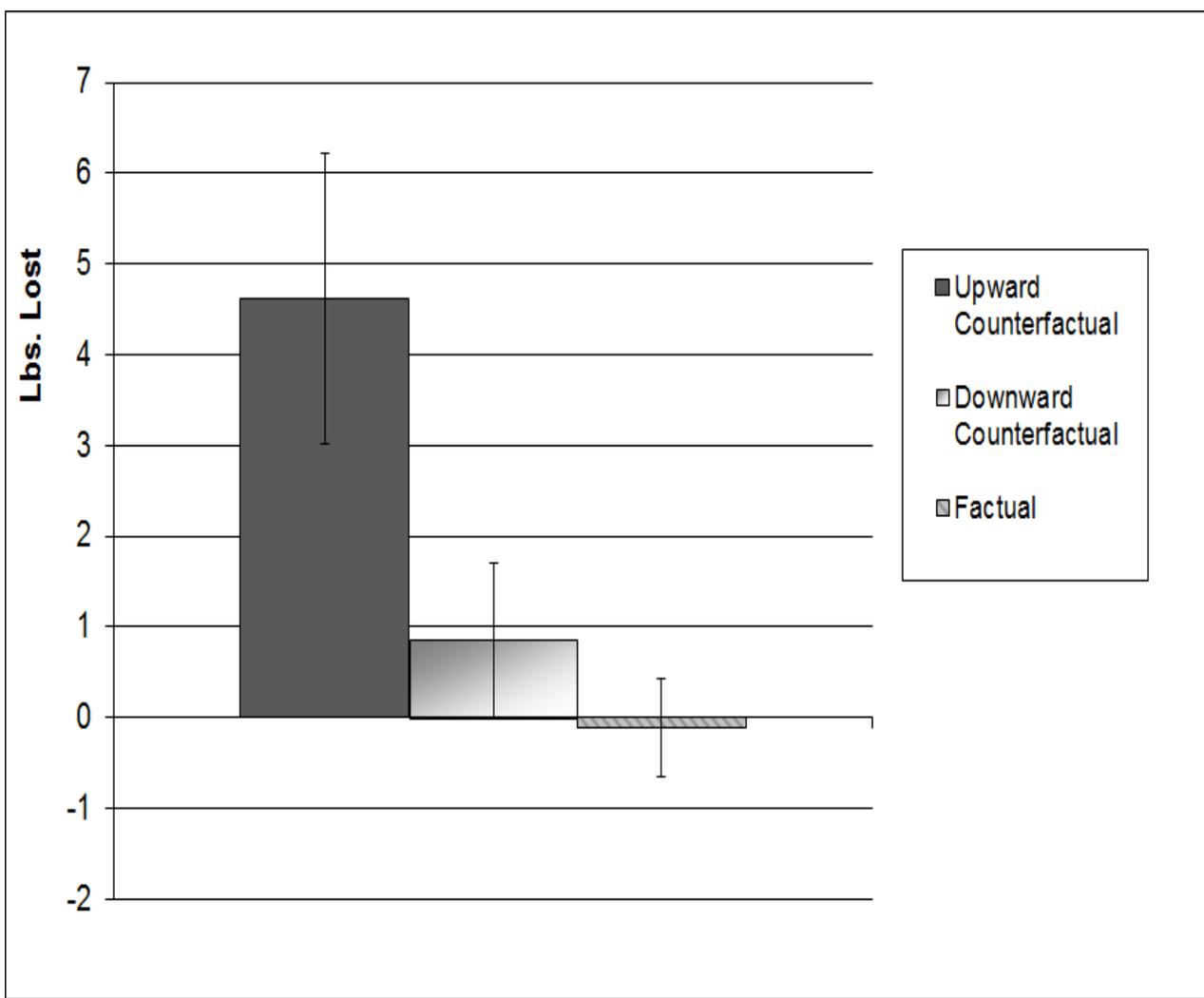
Counterfactuals and Behavior Regulation



Note. This figure displays measures of behavior from studies 1 and 2. Corrective action is whether some form of action was taken between time points to improve the event/situation that was described at Time 1. Adaptive behavior is defined declining to eat any M&Ms at the final study session (Time 3) in study 2.

Figure 4

Upward Versus Downward Counterfactual and Factual Thoughts Over 2 Months: Weight Lost

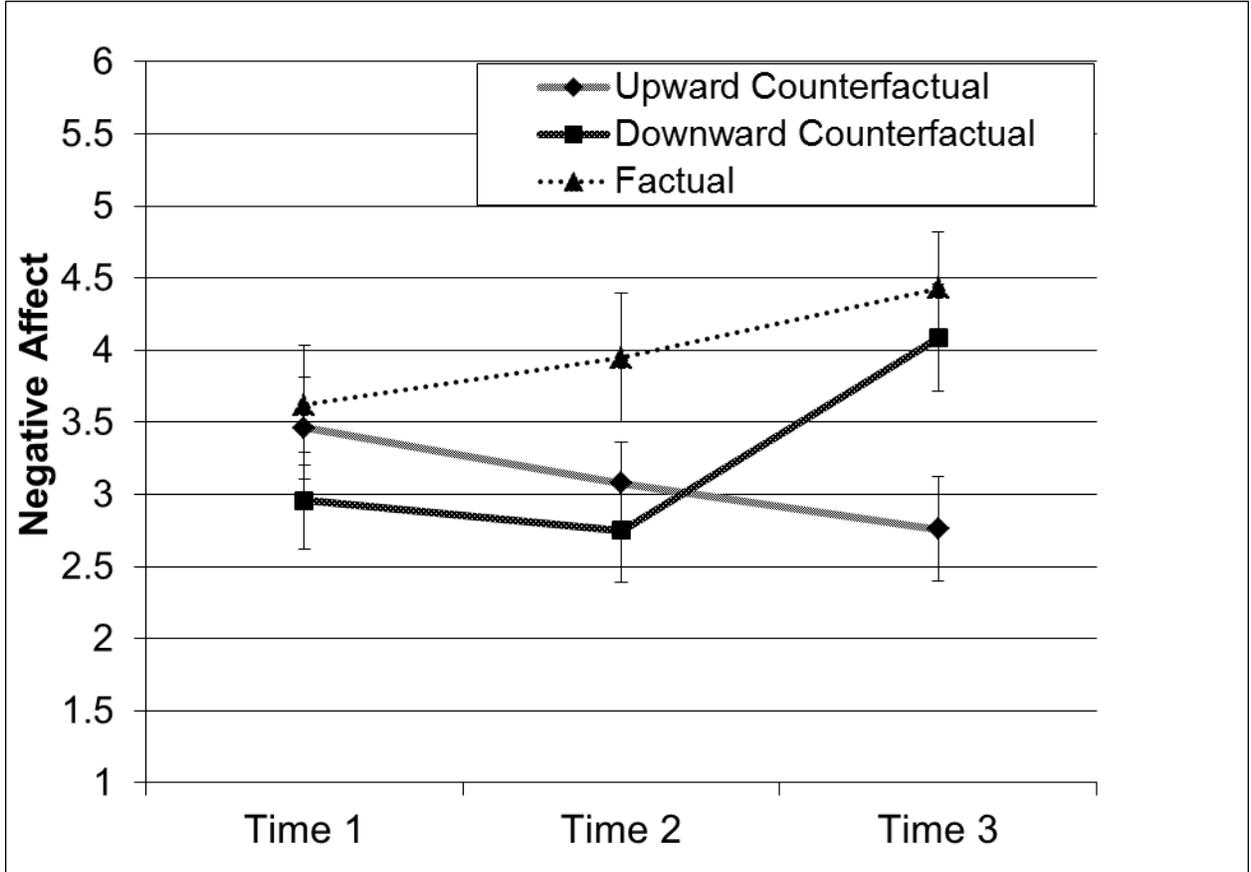


Note. This figure displays actual weight lost by Study 3 participants in the different conditions from the first session to the last session of the study.

Figure 5

Upward Versus Downward Counterfactual and Factual Thoughts Over 2 Months: Negative

Affect



Note. This figure displays self-reported ratings of negative affect ("I feel sad when I think about how my dieting has gone over the past month") over three time points that were approximately one month apart.