



Reports

Buffering against weight gain following dieting setbacks: An implicit theory intervention [☆]

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ABSTRACT

Research on implicit theories suggests that *incremental beliefs*—that attributes are malleable—can help buffer people against the adverse effects of setbacks on goal achievement. We conducted a longitudinal experiment to examine whether an incremental beliefs intervention could help dieters manage their body weight in the face of severe dieting setbacks. To explore the efficacy of our incremental beliefs intervention, we randomly assigned individuals to a control, a knowledge, or an incremental beliefs condition. In addition to examining the main effect of intervention condition on weight-loss across a 12-week period, we also tested the hypothesis that although participants assigned to the control or knowledge intervention condition would gain more weight as dieting setbacks became more severe, participants assigned to the incremental beliefs condition would not. Results supported this hypothesis: Incremental beliefs protected against setback-related weight-gain. Implications for integrating implicit beliefs interventions with obesity relapse prevention programs are discussed.

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Introduction

Maintaining a healthy body weight is difficult, as illustrated by the 34% of Americans who are obese (BMI > 30) and the additional 34% who are overweight (BMI > 25) (Flegal, Carroll, Ogden, & Curtin, 2010). Millions of people diet (Hill, 2002), but most of them ultimately *gain* weight (Mann et al., 2007). Our “obesogenic environment” yields nearly inevitable setbacks in the pursuit of nutrition and exercise goals (e.g., Brownell & Rodin, 1994; Lowe, 2003; Stroebe, 2008), which, in turn, frequently cause weight gain (Cochran & Tesser, 1996; Polivy & Herman, 1985).

This article reports the results of a longitudinal intervention designed to buffer dieters against setback-related weight gain by altering their implicit theories of body weight (Dweck, 2000; Molden & Dweck, 2006). This intervention was designed to foster the belief that body weight is changeable (Burnette, 2010). Parallel *incremental beliefs*—that attributes are malleable and, consequently, that one is not destined to long-term failure following poor performance—in the academic domains buffer against the adverse effects of academic setbacks on academic performance (Blackwell, Trzesniewski, & Dweck, 2007). In the present article we (a) develop a novel implicit theory of body weight

intervention to help individuals reach their weight-loss goals; (b) compare this incremental beliefs intervention to a comprehensive information-based weight-loss intervention; (c) test whether changes in incremental beliefs mediate any links between the incremental beliefs intervention and changes in body weight, and (d) discuss applications of our findings for obesity relapse prevention programs.

The sole emphasis of the *incremental beliefs intervention* was presenting evidence that body weight is malleable. This minimalist intervention offered no information about exercise or nutrition, no training on weight-loss strategies, and no lifestyle change recommendations for reaching weight-loss goals. In line with implicit theory research (Dweck & Leggett, 1988), our major prediction was that the incremental beliefs intervention would be especially relevant in times of threats to one's ability. As such, we focused on weight change after setbacks to one's dieting goals.

When confronting dieting-related setbacks (e.g., overeating at a party), knowledge related to lifestyle, nutrition and exercise may not be very useful. Motivation to behave in accord with such knowledge wanes as dieters become frustrated with unavoidable temptations (Herman & Polivy, 2011). Indeed, dieters often exhibit the “what-the-hell” effect, disengaging entirely from their goal following setbacks in favor of unrestrained indulgence (Polivy & Herman, 1985). The what-the-hell effect emerges when dieters drink a milkshake in a taste perception task (Herman & Mack, 1975); when they observe a model overeating (Polivy, Herman, Younger, & Erskine, 1979); and even when they merely *think* they consumed a few extra calories, regardless of whether they have actually done so (Polivy, 1976). In the current article, we suggest that an incremental

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message can help buffer dieters against succumbing to the what-the-hell effect after severe dieting setbacks.

We suggest that the incremental intervention is likely to do so for two reasons. First, incremental messages inculcate a mindset that encourages dieters to remain motivated instead of disengaging from their goal after dieting setbacks. To avoid falling prey to the what-the-hell effect, dieters must believe that they have the ability to change their outcomes, which is precisely what an incremental message can achieve. For example, participants in a recent one-shot laboratory experiment who read a brief article suggesting that body weight is malleable (an incremental message) responded to hypothetical dieting setbacks with greater confidence in their opportunity for future success and less goal disengagement, relative to participants who read a brief article suggesting that body weight is fixed (an entity message; Burnette, 2010). Second, across achievement contexts, incremental messages help to foster effective self-regulatory strategies when facing setbacks (Burnette et al., 2011; Dweck, 2000).

These motivational and self-regulatory benefits of incremental beliefs can ultimately promote better goal achievement in the face of setbacks. For example, in academic interventions, encouraging students to hold an incremental theory helps to buffer against the typical decline in grade point average following the transition from elementary school to the more challenging context of middle school (Blackwell et al., 2007). In short, incremental messages can buffer against setbacks by providing a mindset that helps individuals remain motivated to achieve their goals. Such interventions do not inculcate the skills necessary to eat more healthfully (or to study more effectively), but rather we suggest that the motivational and self-regulatory consequences of holding incremental beliefs buffer people against setback-related weight gain.

Given that setbacks to one's eating and exercise goals predict weight gain (e.g., Ulen, Huizinga, Beech, & Elasy, 2008), and that incremental beliefs work to buffer people against the deleterious effects of setbacks on goal achievement, we predicted that participants facing severe setbacks would be able to avoid weight-gain over the present 12-week study if they were in the incremental beliefs condition rather than the no-intervention control condition. However, given that incremental beliefs rarely directly influence motivation and subsequent achievement (e.g., in the absence of adversity; Dweck & Leggett, 1988; Cury, Da Fonseca, Zahn, & Elliot, 2008; Plaks & Stecher, 2007), we expected that participants in the incremental beliefs intervention would not differ from those in the control condition when facing mild setbacks to their eating and exercise goals.

We also included a third condition to provide a broader context for interpreting changes in body weight in the incremental beliefs and the control conditions. In this third condition, the *knowledge* intervention, we employed the strongest comparison condition we could generate in light of our Web-based intervention procedures, providing participants with a broad range of scientifically validated information for promoting weight-loss. We focused on the main pillars of the LEARN program for successful weight-loss (Brownell, 1997), one of the most comprehensive and efficacious approaches to weight management. We incorporated information related to lifestyle (e.g., reduce pace of eating), exercise (e.g., information on understanding mechanisms linking exercise to weight-control) and nutrition (e.g., maximize fiber). We also provided healthy recipes and strategies for reaching weight-loss goals. Given that we provided participants with information that has been shown to be useful in controlling weight, we expected that participants in this condition would lose more weight over this 12-week study than would participants in the control condition. This knowledge condition was especially relevant to the present research as a comparison for the incremental beliefs intervention for participants confronting setbacks. Specifically, we hypothesized that any potential advantage of the LEARN-inspired knowledge condition over the incremental beliefs condition should be significantly smaller (perhaps even nonexistent) as individuals confronted setbacks of greater severity.

In sum, we advanced three hypotheses. First, the *intervention hypothesis* was that participants in the incremental beliefs intervention would

lose more weight at Time 2 than would participants in the control condition, although we suspected that participants in the knowledge condition might lose even more weight than participants in the incremental beliefs condition because the knowledge condition was a much more extensive intervention. Second, the *mechanism hypothesis* was that changes in incremental beliefs are the driving mechanism behind changes in weight from Time 1 to Time 2. Third, and most importantly, the *incremental buffering hypothesis* was that participants assigned to the knowledge or control condition would gain more weight as setbacks became more severe, whereas participants assigned to the incremental beliefs condition would not. Another way of conceptualizing this third hypothesis is that the knowledge intervention, with its proven weight-control information, would be most effective at promoting weight-loss when setbacks are mild, but that its advantages over the incremental beliefs intervention would be smaller (perhaps even nonexistent) when setbacks are severe.

Method

To test our three hypotheses, we recruited 169 participants (80% female) who were currently trying to lose weight, with the majority (61%) having dieted at least twice in the previous year. We focused on such a population because restrained eaters are especially susceptible both to the "what-the-hell" effect and to weight gain after dieting setbacks (e.g., Polivy & Herman, 1985). According to the weight measurement we took at Time 1 (T1), 81% had BMI scores in the overweight or obese range, with the mean weight exceeding the threshold for obesity ($M = 30.56$, $SD = 6.71$). Participants were 42 years old, on average ($SD = 16$) and the majority were White (79% White, 16% Black, 3% Asian, 2% Hispanic).

At T1, we also assessed naturally occurring implicit theory of weight [e.g., "Your weight is something about you that you can't change" (reverse-scored item); 1 = *strongly disagree*, 6 = *agree strongly*; $\alpha = .89$; Burnette, 2010]. In addition, for use in control analyses, we assessed dieting self-efficacy (e.g., "I usually feel confident in my ability to manage my weight"; 1 = *strongly disagree*, 7 = *agree strongly*; $\alpha = .82$; Burnette, 2010), nutrition coping self-efficacy (e.g., "I can manage to stick to healthy foods even if I have to try several times until it works"; 1 = *very uncertain*, 4 = *very certain*; $\alpha = .86$) and exercise coping self-efficacy (e.g., "I can manage to carry out my exercise intentions even if I am tired"; 1 = *very uncertain*, 4 = *very certain*; 1 = *strongly disagree*, 7 = *agree strongly*; $\alpha = .90$; Schwarzer & Renner, 2000).

In all three conditions, we sent participants five biweekly emails, adapting procedures from successful implicit theory interventions in academic contexts (Blackwell et al., 2007; Good, Aronson, & Inzlicht, 2003) and incorporating tactics to induce lasting attitude change (Aronson, Fried, & Good, 2002). In the two intervention conditions, these emails contained links to a Website we designed to present the intervention-relevant information (see Table 1); in the control condition, these emails provided no information regarding body weight.

Twelve weeks after Time 1, 125 participants¹ (102 females; incremental condition = 33 females; knowledge condition = 33 females; control condition = 36 females) attended the Time 2 (T2) laboratory session and provided a second weight assessment. We assessed *setback severity* by asking participants to characterize the severity of any setback they experienced over the preceding 12 weeks (1 = *not all*, 5 = *extremely*; $M = 2.76$, $SD = 1.19$). We gave participants freedom to select the relevant setback (rather than asking them to report on, say, their most serious setback) because we sought to access their natural, unaltered cognitive evaluations—the information that was accessible to them as they reflected upon a specific setback over the previous 12 weeks.² Self-reported setback severity did not differ across condition, $p = .753$. Additionally, two

¹ Our 74% retention rate is comparable to the rates for other weight-relevant interventions of comparable duration (e.g., Honas, Early, Frederickson, & O'Brien, 2003). Experimental condition was unrelated to dropout rate, $p = .409$.

² The 18 participants who did not experience a setback and therefore had missing severity data were comparably distributed across experimental conditions, $p = .285$.

Table 1
Summary of the biweekly intervention protocols.

Session	Module	Knowledge condition	Incremental condition
1–2	Readings	Lifestyle (e.g., eat more slowly), exercise (e.g., exercise more often and for shorter periods of time), and nutrition (e.g., importance of fiber) strategies adapted from pillars of weight-loss success in LEARN (Brownell, 1997)	Weight is changeable message: Genes may provide an initial map and framework, but, through hard work and effort, one can change one's body-weight
3	Video	Exercise is crucial for weight-loss (e.g., explanations of how muscle mass can promote weight-loss)	With effort, people can reach and maintain their desired body weight, regardless of their family history (e.g., it is not the hand one is dealt that matters, it's how we play that hand)
4	Examples	Healthy recipes and nutritional tips (e.g., how to balance among important food groups)	Examples of people who have successfully lost weight
5	Summary	Summary of key strategies for achieving weight loss goals and a maintaining a sustainable healthy eating regimen	Summary of the incremental message and evidence supporting the validity of incremental beliefs of weight

independent raters blind to condition coded setbacks for severity (e.g., “The setback was severe”; “The setback seems likely to lead to weight gain”; 1 = *strongly disagree*, 9 = *strongly agree*; $\alpha = .97$; inter-rater $r = .87$), and these objective ratings also did not differ by condition, $p = .496$. At T2, as a manipulation check, participants completed the same measure assessing incremental beliefs regarding body weight as at T1 ($\alpha = .84$; Burnette, 2010). In addition, for use in control analyses, participants completed a 1-item measure of perceived weight-loss goal performance (1 = *complete failure*, 7 = *complete success*).

Results

Manipulation check

Before conducting hypothesis tests, we tested whether participants in the incremental condition exhibited stronger incremental beliefs regarding body weight at T2 than participants in the other two conditions (neither of which included any information about the malleability of body weight). As expected, an independent samples *t*-test revealed that, at T2, participants in the incremental intervention ($M = 5.17$, $SD = 0.70$) believed more strongly in the malleability of body weight than did participants in the other two conditions ($M = 4.84$, $SD = 0.91$), $t(124) = 2.10$, $p = .038$. We also examined if participants in the incremental condition exhibited greater changes towards incremental beliefs regarding body weight from T1 to T2 than participants in the other two conditions. A 2 (Time 1 vs. Time 2) \times 2 (incremental beliefs vs. experimental conditions) mixed model ANOVA yielded similar conclusions: Participants in the incremental condition became more incremental in their beliefs from T1 to T2 (T1: $M = 4.96$, $SD = 0.85$; T2: $M = 5.17$, $SD = 0.80$), whereas participants in the other two conditions trended the opposite direction (T1: $M = 4.99$, $SD = 0.69$; T2: $M = 4.83$, $SD = 0.92$), $F(1, 120) = 3.52$, $p = .063$.

H1: Intervention hypothesis

Our first hypothesis was that participants in the incremental beliefs intervention would lose more weight at T2 than would participants in the control condition. We regressed T2 weight onto two dummy variables, which we created—using the control condition as the reference group—to represent our three-level experimental factor, controlling for T1 weight. Both the knowledge, $b = -4.96$, $t(121) = -3.60$, $p < .001$, and the incremental beliefs, $b = -3.00$, $t(121) = -2.31$, $p = .023$, dummy variables were significant. Although participants failed to lose weight, participants in both intervention conditions had gained less weight by T2 than did participants in the control condition. In a separate analysis to examine whether the participants in the knowledge condition weighed less at T2 than those in the incremental condition, we re-ran analyses using the incremental intervention as the comparison condition. Although the means trended in the expected direction, the two intervention

conditions did not differ significantly from each other, $p = .16$ (see Table 2).³

H2: Mechanism hypothesis

Our second hypothesis was that differences between the incremental and control conditions in T2 weight, controlling for T1 weight, were driven by changes in incremental beliefs. Upon first blush, it might seem that the optimal way to examine this hypothesis is by performing a standard mediation analysis (condition \rightarrow change in beliefs \rightarrow T2 weight) to examine whether the effect of condition on T2 weight becomes significantly smaller after adding change in beliefs to the model. However, such an analysis is not theoretically sensible because our hypothesis was that condition would influence T2 weight and change in incremental beliefs in different ways. Specifically, regarding the dependent measure, we hypothesized that participants in the incremental condition would gain less weight than participants in the control condition, and, if anything, that participants in the knowledge condition would weigh least of all (knowledge < incremental beliefs < control). In contrast, regarding the mediator, we hypothesized that participants in the incremental condition would become more incremental in their beliefs from T1 to T2, whereas participants in the other two conditions would not (incremental beliefs > knowledge = control). That is, we hypothesized that the incremental beliefs condition would differ from only the control condition (i.e., it would be similar to knowledge condition) when predicting T2 weight, whereas it would differ from both of the other two conditions when predicting change in incremental beliefs. As reported previously, results generally supported these hypotheses (although, in a finding of tangential importance to our main goals, the knowledge intervention did not yield significantly better weight outcomes than the incremental beliefs intervention).

Given that standard mediation was not a sensible approach, we followed the recommendations of Spencer, Zanna, and Fong (2005), who argue that, in situations like ours, the best way to establish whether the putative mediator (theory change) is in fact a driving mechanism is to consider “the within-cell correlations between the mediator and the dependent variable in each cell of the design” (p. 850). First, we calculated changes in implicit theories (mediator) by subtracting the Time 1 scores from Time 2 scores; positive scores represented increases and negative scores represented decreases over time (e.g., higher numbers represent relatively increasing incremental beliefs). Next, we examined the association of changes in implicit theories with weight at T2, controlling for weight at T1,

³ We also ran a 2 (T1 vs. T2) \times 3 (incremental beliefs vs. knowledge vs. control condition) mixed-model ANOVA to examine weight change in each condition. The time \times condition interaction was significant, $F(2, 122) = 6.76$, $p = .002$. Simple effects demonstrated that, across the 12-week study, participants gained a significant amount of weight ($M = 3.11$ lb, $p = .002$) in the control condition, lost a marginally significant amount of weight ($M = -1.83$ lb, $p = .066$) in the knowledge condition, and neither gained nor lost any significant amount of weight in the incremental beliefs condition ($M = 0.09$ lb, $p = .924$).

Table 2
Time 1 and Time 2 weight by experimental condition.

	Incremental condition	Knowledge condition	Control condition
Time 1 weight	190.39 lb (SD = 40.93)	179.11 lb (SD = 51.76)	185.13 lb (SD = 40.44)
Time 2 weight	190.48 lb (SD = 41.40)	177.28 lb (SD = 51.37)	188.24 lb (SD = 41.19)
Difference (T2 – T1)	+ 0.09 lb	– 1.83 lb	+ 3.11 lb

separately across the three experimental conditions. As predicted, this association was significant (and negative, as hypothesized) only in the incremental beliefs condition, $b = -1.78$, $t(44) = -2.21$, $p = .033$; it did not approach significance in either of the other two conditions (knowledge: $b = -0.37$, $t(35) = -0.43$, $p = .671$; control, $b = -0.31$, $t(43) = -0.36$, $p = .723$). For participants in the incremental beliefs condition, and *only* for those participants, greater increases in incremental beliefs predicted greater decreases in weight. This effect, which corresponds to a moderately strong association ($r = -.322$), suggests that an important reason why the incremental beliefs intervention helped participants avoid the weight-gain exhibited by participants in the control condition is that it increased their beliefs that body weight is malleable.

The combination of the significant association of changes in implicit theories and T2 weight ($b = -1.78$) and the lack of weight change from T1 to T2 ($M = 0.08$ lb; see Footnote 3 and Table 2) for participants in the incremental beliefs condition is intriguing. What does the significant relation between theory change and weight-loss mean in light of the non-significant weight change over time for individuals in the incremental condition? We hypothesized that participants for whom the intervention successfully inculcated an increase in incremental beliefs would exhibit weight-loss over time, whereas participants for whom the intervention did not inculcate such an increase would, like participants in the control condition, exhibit weight-gain over time.

To test this hypothesis, we conducted a set of analyses on the 45 participants in the incremental beliefs condition to test whether their weight change over time varied as a function of changes in their incremental beliefs. We conducted a multilevel modeling analysis (Raudenbush & Bryk, 2002) predicting weight from change in incremental beliefs; the two weight assessments (T1 and T2) were nested within person. This analysis revealed a significant time \times change in beliefs interaction effect, $b = -2.18$, $t(42) = -2.56$, $p = .014$. As predicted, participants for whom the intervention successfully inculcated an increase in incremental beliefs (+1 SD) lost weight over time, $b = -2.32$, $t(42) = -1.92$, $p = .061$, whereas participants for whom the intervention did not inculcate such an increase (–1 SD) gained weight over time, $b = 2.03$, $t(42) = 1.69$, $p = .098$. That these marginally significant simple effects (underneath

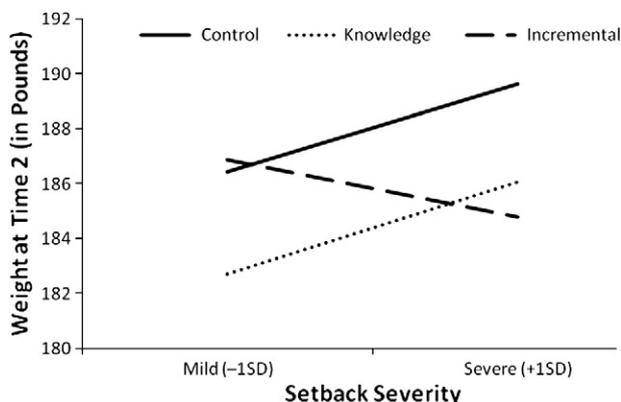


Fig. 1. Predicting Time 2 weight from setback severity, intervention condition, and their interaction, controlling for Time 1 weight.

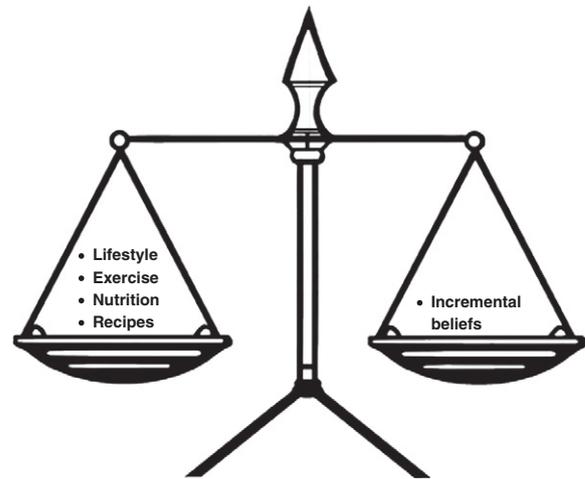


Fig. 2. Comparison of materials in two experimental conditions.

the significant interaction effect) trended in the opposite direction explains the overall lack of weight change in the incremental beliefs condition. When participants internalized the intervention, changing their beliefs accordingly, they lost weight. When they did not, they gained weight, as would be expected in light of the weight-gain among participants in the control condition.

H3: Incremental buffering hypothesis

Our third hypothesis was that incremental theories buffer against weight gain associated with severe dieting setbacks. We regressed T2 weight onto two dummy variables representing our three experimental conditions (as before, the control condition was the reference group), setback severity, and the interaction of setback severity with each of the dummy variables, controlling for T1 weight. Setback severity predicted (marginally) greater T2 weight, $b = 1.60$, $t(100) = 1.78$, $p = .078$. Most importantly, however, this association was moderated by the incremental intervention dummy variable, $b = -2.65$, $t(100) = -2.10$, $p = .038$, but not by the knowledge intervention dummy variable, $p = .955$ (see Fig. 1). Controlling for T1 weight, participants in the knowledge and the control conditions exhibited a positive association of setback severity with T2 weight, $b = 1.78$, $t(64) = 2.46$, $p = .017$. In contrast, participants in the incremental condition exhibited a nonsignificant (and negative-trending) association of setback severity with T2 weight, $b = -1.10$, $t(37) = -1.14$, $p = .262$, suggesting that the incremental intervention completely buffered participants against setback-related weight-gain. Indeed, as depicted on the right side of Fig. 1, the incremental beliefs intervention was every bit as effective as (even nonsignificantly *more* effective than) the knowledge intervention for participants who confronted severe setbacks.⁴ For each standard deviation increase in setback severity, participants in the knowledge and the control conditions weighed 1.78 lb more (beyond general tendencies toward weight gain), whereas participants in the incremental condition weighed 1.10 lb less. In addition, we replicated our moderational analysis after controlling for the potential direct effects of dieting self-efficacy, nutrition self-efficacy, exercise self-efficacy, and perceived goal performance. All hypothesis tests reported in this paragraph yielded identical conclusions in this rigorous confound analysis.⁵

⁴ Participant sex exhibited no main or interactive effects in auxiliary analyses predicting T2 weight and controlling for T1 weight.

⁵ A separate analysis, including the eight interaction terms involving the four potential confounds and each of the two dummy variables, demonstrated that (a) none of these interaction terms was even marginally significant and (b) our key analyses remained significant or marginally significant.

Discussion

Modernity has brought ever-increasing access to fattening food, which renders dieting setbacks virtually inevitable in wealthy countries (Brownell & Horgan, 2004; Kessler, 2009; Stroebe, 2008; Wansink, 2006). Our longitudinal intervention demonstrated that both the incremental and the knowledge interventions buffer against the natural trend toward weight-gain. Additionally, for participants for whom the intervention successfully inculcated an increase in incremental beliefs, it even reversed this trend; individuals in the incremental condition who adopted more incremental beliefs actually lost weight from T1 to T2. Furthermore, incremental beliefs buffered against setback-related weight-gain: Although setback severity predicted weight-gain for participants in the control and the knowledge intervention conditions, this link was nonsignificant (and negative-trending) for participants in the incremental beliefs condition. The knowledge intervention was more effective than the incremental beliefs intervention when setbacks were mild, but this effect disappeared (and nonsignificantly reversed) when setbacks were severe (see Fig. 1).

We were somewhat surprised that the minimalist incremental beliefs intervention appeared to be just as effective as the knowledge intervention overall (the conditions did not differ significantly). After all, the incremental beliefs intervention only stressed the changeable nature of body weight, offering no other information or strategies regarding weight-loss-promoting lifestyles, nutrition, exercise, or recipes. In contrast, the knowledge condition included all of these features, which are critical components of past weight-loss interventions. Fig. 2 visually depicts the comparison between these two interventions, emphasizing that neither was clearly superior to the other in terms of weight at T2.

The present results suggest that incorporating incremental beliefs training into broader dieting regimens holds promise for helping people avoid weight gain (and perhaps lose weight), especially when confronting severe dieting setbacks. Based on findings from the current study, an incremental beliefs intervention could be incorporated into larger scale relapse prevention programs that focus on helping individuals to cope successfully with setbacks (Marlatt & Gordon, 1985). The minimal contact procedures and short duration make our incremental beliefs intervention easy and inexpensive to administer. Furthermore, these findings highlight that small changes in beliefs may be all that is needed to buffer against setback-related weight gain. Future research could fruitfully merge our incremental beliefs intervention with attitude inoculation procedures and other weight control programs. Such integration holds promise for promoting successful weight-management—including maintenance of weight-loss in the face of dieting setbacks, the holy grail of obesity prevention.

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