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Research report

Motivation and goal attainment. The role of compensatory beliefs ☆

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A B S T R A C T

It was recently proposed that one cognitive strategy people might employ to find a balance between fulfilling their immediate desires and adhering to their long-term goals is to activate compensatory beliefs (CBs). CBs are convictions that the negative effects of a behavior can be compensated for by the positive effects of another behavior (e.g., "I can eat this piece of cake now because I will go to the gym tonight".). The purpose of the present research was to examine the motivational determinants and consequences of CBs in weight-loss dieting. It was proposed that autonomous motivation would lessen the activation of CBs. It was further proposed that activating CBs would decrease goal adherence, which, itself, would facilitate the attainment of one's dieting goals. Results of a prospective study using path analysis provided support for the model.

Introduction

Many individuals have difficulties reaching an optimal equilibrium between fulfilling their immediate desires and adhering to their long-term goals (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister, Heatherton, & Tice, 1994; Metcalfe & Mischel, 1999; Muraven & Baumeister, 2000). In other words, they strive to find a balance between maximizing pleasure and minimizing harm, which has been referred to as the pleasure or hedonic principle (Higgins, 1997). For example, people are faced with temptations and desires such as eating delicious but unhealthy foods, smoking, spending money, or drinking alcohol, but also hold long-term goals such as remaining healthy, saving for a house, losing weight, or being athletic. Therefore, being able to exert self-control, that is, resist temptation, is a key factor in the course of goal pursuit (Metcalfe & Mischel, 1999).

It was recently proposed that one cognitive strategy people might employ to reach this equilibrium is the activation of compensatory beliefs (CBs) (Knäuper, Rabiau, Cohen, & Patriciu, 2004). CBs are beliefs that the negative effects of a behavior can be compensated for, or "neutralized", by the positive effects of another behavior. It was proposed that people employ cognitive beliefs in anticipation of or subsequently to succumbing to a temptation. "I can eat this piece of cake now because I will go to the gym tonight" is an example of a justification that people might use for giving in to immediate pleasures. The compensatory beliefs model (Knäuper et al., 2004), which has been integrated into self-determination theory (SDT; Deci & Ryan, 2000) by Rabiau, Knäuper, and Miquelon (2006) aims at explaining why people create CBs and how they employ such beliefs to regulate their behaviors.

So far, there has been little research on CBs. Nevertheless, the studies that actually exist provide evidence that CBs are associated with poorly maintained self-care behavior, including poorer diabetes self-management, greater caloric intake, and readiness to quit smoking (Kronick, Auerbach, Stich, & Knäuper, 2011; Kronick & Knäuper, 2010; Rabiau, Knäuper, Nguyen, Sufrategui, & Polychronakos, 2009; Radtke, Scholz, Keller, & Hornung, 2011b; Radtke, Scholz, Keller, Knäuper, & Hornung, 2011a).

In line with the theoretical framework in which the compensatory beliefs model is embedded, the purpose of the present research was to test the motivational determinants and consequences of CBs in weight-loss dieting. It is proposed that autonomous motivation will decrease the activation of CBs. It is further anticipated that preventing the activation of CBs will increase goal adherence that, in turn, will facilitate goal attainment. The supportive evidence for these proposed relationships is presented below.

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Compensatory beliefs and self-regulation of temptations

According to the compensatory beliefs model (Knäuper et al., 2004), when individuals are faced with a temptation, the conflict between their wish for the desired object or activity and their other goals creates a conflict or anticipatory guilt (cf. Giner-Sorolla, 2001). This conflict can be described as the perception of a discrepancy among cognitions generating a negative intrapersonal state of cognitive dissonance (Festinger, 1957), which, in turn, motivates the individual to seek and implement a strategy to alleviate this unpleasant state. As mentioned above, one of the strategies used to alleviate that state of discomfort might be to activate CBs. In other words, the compensatory beliefs model proposed that when a conflict exists between the desire to indulge in a tempting behavior and the cognitive reasoning of its maladaptive consequences, one way to alleviate it is to activate CBs.

Motivation, compensatory beliefs, and goal attainment

Deci and Ryan (2000) suggested that it is important to distinguish between two types of motivation – namely, *autonomous* and *controlled motivation*, to predict long-term maintenance of motivated behavior change. According to SDT (Deci & Ryan, 2000), autonomous motivation is characterized by the feeling that one has freely chosen to engage in a goal-directed behavior. In other words, autonomous motivation is associated with an internal perceived locus of causality (deCharms, 1968). Thus, when motivation is autonomous, goal-directed behaviors are performed because of strong interests or self-identified personal convictions. As such, they are accompanied by feelings of self-control and self-choice, a sense of purposeful connection to what one is doing, and the capacity to positively relate to others' personal choices. In contrast, controlled motivation is characterized by engaging in a goal-directed behavior because of interpersonal or intrapsychic pressures. As such, controlled motivation is associated with an external perceived locus of causality. Consequently, when motivation is controlled, goal-directed behaviors are performed because of external pushes or rewards, or introjected sanctions characterized by anxiety and guilt.

Substantial research attests to the qualitative advantages of autonomous relative to controlled motivation for effective health behavior change and maintenance. For instance, in a weight-loss context, Williams, Grow, Freedman, Ryan, and Deci (1996) found within obese patients that autonomous motivation for participating in a very low calorie weight loss program was correlated positively with the regularity of attending the 6-month program, weight loss, and weight loss maintenance at 23-month follow-up. These results suggest that successful weight reduction results from people's carrying out personal values related to weight-loss and its health benefits. Similar results have also been found with several other health outcomes such as long-term medication adherence (Williams, Rodin, Ryan, Grolnick, & Deci, 1998), improved glycemic control and dietary self-care in diabetes patients (Williams, Freedman, & Deci, 1998; Williams, McGregor, Zeldman, Freedman, & Deci, 2004), and maintained smoking cessation in adults (Williams, Gagné, Ryan, & Deci, 2002; Williams et al., 2006). These and other studies (see Ryan, Patrick, Deci, & Williams, 2008, for a review) clearly indicate that being autonomous in one's relevant actions, that is, having an internal perceived locus of causality, is a crucial predictor of maintained behavior change.

To summarize, more autonomous regulation has been shown to predict success in many health domains, including weight control (Teixeira et al., 2006; Williams et al., 1996), suggesting that behavior change depends not on complying with demands for change but rather on accepting the regulation for change as one's own and that autonomous motivation is associated with greater behavioral persistence or adherence to goals, and goal attainment, compared to controlled motivation.

In line with the compensatory beliefs model (Knäuper et al., 2004; Rabiau et al., 2006), we suggest that autonomous motivation will reduce the activation of CBs. As previously highlighted, CBs should be activated when individuals face a conflict because they believe that a desired behavior may come at a cost with their self-set goals. However, if they are autonomously motivated to engage in the goal-directed behaviors, they should feel more capable of resisting counterproductive desires (e.g., eating delicious but fatty foods when trying to lose weight) and as such, should not feel the need to activate CBs. In other words, individuals who engage in goal-directed behaviors for more autonomous reasons should form fewer CBs because they feel better able to resist temptations that are interfering with their self-set goals and as such, they feel less need to activate CBs (which are a means to reduce the cognitive dissonance that arises when they are confronted with a temptation that challenges their long-term goals).

We further suggest that activating CBs should lead to lower adherence to self-set goals (e.g., weight loss dieters breaking their diet) because using CBs is a "way out" of engaging in the behaviors required to achieve the goal. For instance, weight loss dieters might eat a piece of cake because they are thinking they will make up for the calories by going to the gym that night. Although one could argue that the compensatory behavior (i.e., the translation of the compensatory belief into action, e.g., going to the gym) would then make up for the temporary lack of adherence to one's goal, compensatory behaviors are oftentimes not carried out even when people have the intention to compensate. Indeed, past research has shown that the correlation between intentions and behavior is often low, due to obstacles that hinder translation of the intention into action (e.g., Gollwitzer & Sheeran, 2006; Johnston, Johnston, Pollard, Kinmonth, & Mant, 2004; Orbell & Sheeran, 1998; Sheeran, 2002). As Rabiau et al. (2006) explained, carrying out compensatory behaviors requires the creation of an intention and a plan to actually perform the compensatory behavior. Even if an intention and plan are formed, individuals often lose sight of their intention to perform the compensatory behavior – with the result that the goal-discrepant behavior (e.g., eating a piece of cake) is not balanced out by a compensatory behavior.

The assumption that engaging in CBs compromises goal pursuit or goal adherence has been demonstrated among individuals with type 1 diabetes (Rabiau et al., 2009), dieters (Kronick & Knäuper, 2010; Kronick et al., 2011) and smokers (Radtke et al., 2011a, 2011b). More specifically, in a sample of adolescents with type 1 diabetes, Rabiau et al. (2009) found that holding more CBs (e.g., "Skipping a meal can make up for not taking insulin") was associated with poorer adherence to diabetes self-care behaviors, such as following a general dietary plan. In a similar manner, Kronick et al. (2011) found, in a population of dieters, that endorsing more CBs (e.g., "Exercising or eating less at the next meal can make up for overeating") predicted a greater number of portions eaten or caloric intake. Moreover, Radtke et al. (2011a, 2001b) have shown that adolescent smokers activate smoking-specific CBs to diminish the perceived health risk caused by smoking and most importantly, that smoking-specific CBs are significantly, negatively related to the readiness to stop smoking.

In sum, individuals who engage in goal-directed behaviors for more autonomous reasons should form fewer CBs because they feel better able to resist temptations that are interfering with their self-set goals and as such, they feel less need to activate CBs. Because compensatory behaviors are oftentimes not carried out, goal adherence is compromised and, consequently, goal attainment should be lower.

The present study

Theory and research presented above provide rationale and support for the relative impact of autonomous motivation on CBs as well as for the influence of CBs on goal adherence and goal attainment. In line with this rationale, the goal of the present research was to examine how initial autonomous motivation would influence CBs activation,[1] goal adherence, and goal attainment (or weight loss) over the course of a diet. A prospective study incorporating three measurement time points was designed to test these hypotheses.

Methods

Participants

Overall, 169 women participated in the study. They were recruited by flyers posted on a university campus searching for females who were currently on a weight loss diet and were between the ages of 18–30 years. Of the 169 women recruited at Time 1 (T1), 121 then completed Time 2 (T2) and Time 3 (T3) measures. Thus, 121 participants were included in the present analyses. These women were on average 21.50 years old ($SD = 3.02$, range: 18–30) and had a body mass index (BMI) of 22.8 ($SD = 4.3$, range: 19.1–35.60). They were 59.7% Caucasian, 20.1% Asian, 3.4% African-American, 5.9% Arab, and 5.0% Latin/Hispanic. The remainder (5.9%) classified themselves as 'other'. As regards to their university major, 19.3% participants indicated that they were majoring in psychology, 19.3% in science, 17.6% in business, 31.9% in arts, 1.7% in medicine or nursing, 3.4% in engineering, 2.5% in education, and finally 4.2% indicated that they were not a student.

We also compared participants who dropped out from the study between T1 and T3 ($N = 48$) with the 121 participants who completed the overall study on age, weight at Time 1 (kg), BMI, and autonomous weight-loss motivation. Mean comparison analyses revealed that there was no difference between participants who dropped out and those who completed the overall study on these variables (all $p > .05$).

Procedure

Ethics approval for the present study was received from the McGill Institutional Review Board. Participants were asked to come to the laboratory to fill out a first questionnaire, which assessed their weight-loss motivation, their weight (pounds or kilograms), their dieting rules, and several other variables (Time 1). All participants read and signed a consent form before completing their first questionnaire. Two weeks later, participants were asked to come to the laboratory again to fill out a second questionnaire assessing their CBs (Time 2). An average of 2 months later, participants were sent a third questionnaire by email to assess adherence to their dieting rules and their weight-loss, as described further below (Time 3). The comparably short 2-months follow-up period was chosen because we wanted to minimize the possibility that participants who are no longer dieting would have regained any of the lost weight. All participants received a financial compensation of 12$ for their time.

Measures

Autonomous weight-loss motivation

In line with Williams et al. (1996), the treatment self-regulation questionnaire (TSRQ) was used to assess autonomous weight-loss motivation or autonomous reasons for being on a weight-loss diet. This questionnaire is patterned after the self-regulation questionnaires introduced by Ryan and Connell (1989) and adapted from a treatment motivation questionnaire used by Ryan, Plant, and O'Malley (1995) to study participation in an alcohol treatment program. The TSRQ assesses participants' autonomous (six items) and controlled reasons (six items) for currently being on a diet. It presents participants with item stems such as: "I am dieting because . . ." and the stems are followed by several reasons that vary in the extent to which they represent autonomous or controlled motivation. Examples of autonomous reasons are: "It's important to me personally to succeed in losing weight" and "I believe it's the best way to help myself". Examples of controlled reasons are: "I want others to see that I am really trying to lose weight" and "I'11 feel like a failure if I don't". Each reason was rated on a 5-point Likert-type rating scale, ranging from *Strongly Disagree* (0) to *Strongly Agree* (4). In the present study, weight-loss autonomous motivation was examined by means of a weight-loss relative autonomy index[2] (Williams, Ryan, & Deci, 2000), formed by subtracting TSRQ-scores on the controlled reasons for being on a weight-loss diet ($\alpha = .77$) from TSRQ-scores on the autonomous reasons for being on a weight-loss diet ($\alpha = .82$).

Dieting compensatory beliefs

The Compensatory Health Beliefs Scale (Knäuper et al., 2004) was used to assess dieting CBs. This scale has been validated in the general population and has been found to show satisfactory validity and reliability. It assesses various CBs related to substance use (e.g., smoking, drinking alcohol), unhealthy sleeping and eating habits, stress, exercise, and weight regulation. Knäuper et al. (2004) found that these various types of CBs were negatively correlated with health-related self-efficacy towards preventive nutrition and alcohol resistance while they were positively correlated with the likelihood of engaging in health-related risk behaviors, the number of illness symptoms reported, and body mass index (BMI). As the focus of the present paper was to examine how autonomous weight-loss motivation influences the extent to which participants generate CBs to justify their diet non-adherence or their unhealthy behavior choices toward weight regulation, only CBs related to weight-loss dieting were used in this study (five items). All items were rated on a 5-point Likert-type rating scale, ranging from *No Truth at All* (0) to *Quite a bit of Truth* (4). Examples of such CBs are: "Breaking a diet today may be compensated for by starting a new diet tomorrow", "Using artificial sweeteners compensates for extra calories" or "Eating dessert is balanced by not sweetening one's coffee". The dieting CBs subscale showed satisfactory internal consistency ($\alpha = .68$).

Dieting adherence

At T1, participants were asked to write down up to eight rules they try to follow during their current diet. They were provided with examples (e.g., 'I will not eat any junk food during my diet') and given space for listing these dieting rules. At T3, they were requested to list their eight rules again (i.e., rules listed at T1). On average, dieters were re-interviewed 8.23 weeks after the T1 assessment. Dieting adherence was assessed by the extent to which participants use the same rules over the 2-month period, i.e., write down the same rules at T1 and at T3. More specifically, for each of the rules mentioned at T3, we coded whether or not the participant had also listed the rule at T1 ("1" if they listed

[1] Because the objective of the present study was an initial empirical test of the possibility to integrate the compensatory beliefs model into SDT, we assessed CBs and not the behavioral component (i.e., assessment of individuals' actual compensatory behaviors). The assessment of the behavioral link between CBs and adherence is thus reserved for future research.

[2] Although the autonomous and controlled motivation subscales of the TSRQ (for a specific target behavior) are often used or examined separately, a relative autonomous motivation index can also be formed by subtracting the average for the controlled reasons from the average for the autonomous reasons. Such an index has been used in previous studies (e.g., Bailis & Segall, 2004; Fortier, Shane, Sweet, O'Sullivan, & Williams, 2007; Zoffmann & Lauritzen, 2006).

the rule at both T1 and T3, and "0" if not). These codes were then summed up for each participant across the eight rules, resulting in a score that ranged from 0 to 6 ($M = 3.31$ $SD = 1.52$). This variable thus indicated to what extent participants were consistent in adhering to the same dieting rules over the 2-month period (they received a higher score if they reported using the same rules at both times). Therefore, dieters who used most or all of the same dieting rules from beginning to end of their diet received the highest scores on the dieting adherence variable. Of note is that within participants who completed the overall study ($N = 121$), 111 (or 92%) were still dieting at the time they completed our dieting adherence measure, while 10 participants had stop dieting for an average of 6.70 days ($SD = 1.9$, range = 3–11). Thus, most of the participants were still dieting at the time they completed our dieting adherence measure and for those who had stopped dieting, the average numbers of days was 6.70 and the maximum numbers of days was 11.

Weight

At T1, participants were asked to report their weight (in pounds or kilograms). They reported their weight again at T3. Reports in pounds were converted to kilograms. On average, participants lost 1.25 kg ($SD = 2.35$, range = −5.00–6.82) over the 8 week interval. In total, 64.7% of the participants lost weight, 23.5% gained weight and 11.8% remained stable.

Results

Preliminary analyses

Prior to analyses, all variables were examined for extreme values, normality, univariate, and multivariate outliers. When looking at the variable body mass index (BMI), we observed that two participants were, according to the WHO, underweight (i.e., their BMI was below 18.5). As some recent research found that underweight women can be less likely to comply or adhere to specific dietary recommendations than normal weight women (Biltoft-Jensen et al., 2009), we first examined these two participants' score on the dieting adherence variable and found that they presented a very low score (i.e., zero) on this specific variable. Given the consideration on the dietary compliance of underweight women, as well as the very low score they obtained on our dietary adherence variable, we decided to exclude them from our analyses. When excluding these two underweight participants, the mean on the dieting adherence variable increases from 3.33 to 3.37. After deleting these cases, 119 cases remained for analysis. All variables were normally distributed and two univariate outliers (*z*-score smaller than −3.29, $p < .001$) were detected on the variable "dieting adherence". As suggested by Tabachnick and Fidell (2001), these two extreme values were recoded to the second lowest value obtained on dieting adherence.

Absolute change in weight was calculated by subtracting T1 Weight from T3 Weight. Thus, positive scores on absolute change in weight indicated weight gain and negative scores on change in weight indicated weight-loss. Table 1 presents the correlation matrix among all variables, including absolute change in weight. Of note is that there was a negative, although not significant, relationship between autonomous motivation and absolute change in weight ($r = -.16$, $p = .09$) as well as a significant relationship between dieting adherence and absolute change in weight ($r = -.19$, $p < .05$). Thus, participants who obtained higher scores on autonomous weight-loss motivation as well as on dieting adherence also tend to have lower (or negative) scores on change in weight.

Path analysis

The hypothesized model was tested using a path analysis (i.e., a structural model with observed variables) with Mplus (Muthen & Muthen, 1998). Mplus was selected because, unlike other commonly used modeling packages, it provides statistics that can be used to calculate separate *p*-values for all of the indirect paths contained in the model. The confidence-interval-based test of mediation recommended by MacKinnon, Lockwood, Hoffman, West, and Sheets (2002) was also conducted, as it could provide a more powerful test of the indirect effect between autonomous weight-loss motivation, CBs, dieting adherence and T3 Weight.

To evaluate the goodness-of-fit of the hypothesized model, the chi-square (χ^2), the *root mean square error of approximation* (RMSEA), the *comparative fit index* (CFI) and the standardized root mean square residual (SRMR) statistics were used. The χ^2 is a conventional null hypothesis significance test for the goodness of fit test. If the discrepancy (expressed as a χ^2 variate) between the model implied covariance and the observed sample covariance is larger than the expected distribution value by a probability usually adjudged at a .05 threshold, then the model is rejected as "not-fitting". Conversely, if the fit statistic is less than the value expected, with a probability of occurrence >.05, then the model is accepted as "fitting". That is, the null hypothesis of "no difference" between the model-implied population covariance and the actual observed sample covariance is not rejected. The RMSEA estimates the lack of fit in a model compared to a saturated model. According to Browne and Cudeck (1993), RMSEA values ⩽.05 can be considered as a good fit, values between .05 and .08 as an adequate fit, and values between .08 and .10 as a mediocre fit, whereas values >.10 are not acceptable. The CFI assesses fit relative to other models. It ranges from zero to one with higher values indicating better fit. A rule of thumb for this index is that .97 is indicative of good fit relative to the independence model, while values greater than .95 may be interpreted as an acceptable fit (Schermelleh-Engel, Moosbrugger, & Müller,

Table 1
Means, standard deviations, and Pearson correlations among variables ($N = 119$).

Variables	*M*	*SD*	1	2	3	4	5
1. Autonomous weight-loss motivation	1.37	1.01					
2. Dieting CBs	.70	.55	−.29**				
3. Dieting adherence	3.37	1.51	.23**	−.33**			
4. T1 weight	64.04	11.33	−.09	.14	−.38**		
5. T3 weight	62.79	11.26	−.12	.16	−.41**	.98**	
6. Change in weight	−1.25	2.35	−.16	.07	−.19*	−.13	.08

Autonomous and controlled weight-loss motivations were assessed with 5-point Likert-type rating scales ranging from *Strongly Disagree* (0) to *Strongly Agree* (4). The weight-loss motivation index was calculated by means of subtracting the score obtained on the controlled scale from the score obtained on the autonomous scale (see Williams et al., 2000). Dieting compensatory beliefs were assessed with 5-point Likert-type rating scales ranging from *No Truth at All* (0) to *Quite a Bit of Truth* (4). Dieting adherence indicates to which extent participants were consistent in adhering to the same dieting rules over the 2-month period. T1 Weight and T3 Weight were measured in kilograms.

* $p < .05$.

** $p < .01$.

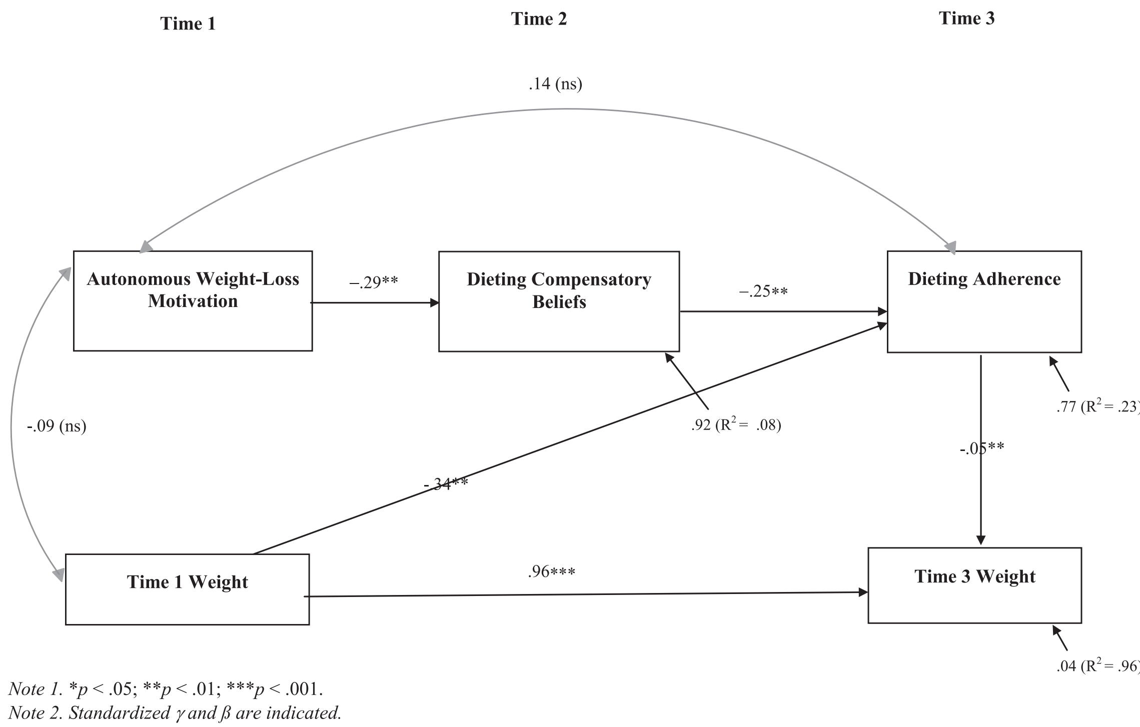

Fig. 1. Results from the longitudinal path analysis on the relationships between autonomous weight-loss motivation, dieting compensatory beliefs, dieting adherence, and T3 Weight (controlling for T1 Weight).

2003). Finally, the SRMR is defined as the standardized difference between the observed correlation and the predicted correlation. Hu and Bentler (1999) suggest that an SRMR "close to .09" represents a reasonable fit (meaning in part that the model was not overly likely to have been the result of too many type I or type II errors).

As shown in Fig. 1, the hypothesized model was composed of two exogenous variables (i.e., autonomous weight-loss motivation as well as weight at Time 1 or T1 Weight) and three endogenous variables (i.e., dieting CBs, dieting adherence, and weight at Time 3 or T3 Weight). The exogenous variables were allowed to covary. Paths[3] were specified according to the proposed hypotheses. Estimation of this initial model revealed poor fit indices, χ^2 ($df = 4$, $N = 119$) = 19.79, $p = .0005$, CFI = .96, RMSEA = .18 [90% CI .11; .27], and SRMR = .12, indicating that the fit of the model to the data could be substantially improved.

Upon examination of the standardized residuals and modification indices, it was determined that a path needed to be added between T1 Weight and dietary adherence. Adding the path from T1 Weight to dietary adherence was in fact consistent with results of the correlational analyses. These analyses revealed that both variables were significantly negatively correlated. A path between T1 Weight and dietary adherence was thus added to the initial model and it was rerun. Results of the path analysis revealed a satisfactory fit of this revised model to the data. The chi-square value was non-significant, χ^2 ($df = 3$, $N = 119$) = 3.88, $p = .27$, and other fit indices were relatively high; CFI = .99, RMSEA = .05 [90% CI .00; .10], SRMR = .04. As shown in Fig. 1, the estimated path between autonomous weight-loss motivation and dieting CBs was significant ($\beta = -.29$, $SE = .06$, $p < .01$). As was further expected, the estimated path between dieting CBs and dieting adherence was significant ($\beta = -.25$, $SE = .20$, $p < .01$), controlling for T1 Weight ($\beta = -.34$, $SE = .01$, $p < .01$). Moreover, the estimated path between dieting adherence and T3 Weight was significant ($\beta = -.05$, $SE = .14$, $p < .01$), controlling for T1 Weight on T3 Weight ($\beta = .96$, $SE = .02$, $p < .001$). This revised model was retained as the final model.

In addition and most importantly, results of the path analysis indicated that while dieting CBs emerged as a significant predictor ($\beta = -.25$, $SE = .20$, $p < .01$) of dieting adherence in the model, the effect of autonomous weight-loss motivation on dieting adherence dropped to non-significance ($\beta = .14$, $SE = .13$, ns). This suggests that dieting CBs mediated the link between autonomous weight-loss motivation and dieting adherence. In order to verify if the autonomous weight-loss motivation indirect effect to dieting adherence via dieting CBs was completed, the direct path from autonomous weight-loss motivation to dieting adherence was constrained to zero (still including T1 Weight as a control). Model comparison was assessed by looking at the delta chi-square statistic.[4] The chi-square difference value was significant, indicating that constraining the parameters of the nested model significantly worsens the fit of the model. The results therefore suggest that the path between autonomous weight-loss motivation and dieting adherence was not equal to zero and was an important element in the overall fit of the model. In other words, the influence of motivation on dieting adherence appeared to be partially carried out by dieting CBs, supporting the assumption that the influence of motivation on dieting adherence can be in part explained by dieting CBs.

Testing the significance of the indirect effects proposed in the model

The indirect effects proposed in the model (i.e., the autonomous weight-loss motivation indirect effect to dieting adherence via

[3] In the text and tables throughout this article, βs refer to standardized regression coefficients.

[4] When using the delta chi-square statistic, the chi-square value and degrees of freedom of the less restrictive model are subtracted from the chi-square value and degrees of freedom of the nested, more restrictive model. The chi-square difference value is compared to the chi-square value in a chi-square table using the difference in degrees of freedom between the more restrictive and less restrictive models.

Table 2
Bootstrap analyses of the magnitude and statistical significance of indirect effects ($N = 119$).

Specific indirect effect	Mean indirect effect	*SE* of mean	95% CI mean indirect effect (lower and upper)
Autonomous weight-loss motivation, dieting CBs and dieting adherence	.11, $p < .05$[a] .07, $p < .05$[b]	.04[a] .03[b]	(.035, .210)[a] (.013, .131)[b]
Dieting CBs, dieting adherence and T3 weight	.25, $p < .05$[a] .01, $p < .05$[b]	.11[a] .006[b]	(.056, .478)[a] (.001, .023)[b]
Autonomous weight-loss motivation, dieting CBs, dieting adherence and T3 weight	−.04, $p = .09$[a] −.003, $p = .10$[b]	.02[a] .002[b]	(−.099, −.012)[a] (−.007, .000)[b]

Note. CI, confidence interval.
[a] These values are based on unstandardized path coefficients.
[b] These values are based on standardized path coefficients.

dieting CBs, the dieting CBs indirect effect to T3 weight via dieting adherence and the autonomous weight-loss motivation indirect effect to T3 Weight via dieting CBs and dieting adherence) were tested using the bias-corrected bootstrap confidence limits. Significance was assessed by whether or not the 95% confidence limits contained zero. This approach takes the non-normality of the multiplicative distribution into account (resulting in asymmetric confidence limits) and has been shown to provide the most accurate confidence limits and greatest statistical power when compared with other existing approaches for detecting mediation (MacKinnon, Lockwood, & Williams, 2004; MacKinnon et al., 2002; Shrout & Bolger, 2002). Using 1000 resamples, the autonomous weight-loss motivation indirect effect to dieting adherence via dieting CBs (.07, $SE = .03$, $p < .05$, 95% CI = .013–.131) was significant. Likewise, the CBs indirect effect to T3 Weight via dieting adherence (.01, $SE = .006$, $p < .05$, 95% CI = .001–.023) was also significant. Finally, the autonomous weight-loss motivation indirect effect to T3 Weight via both dieting CBs and dieting adherence was marginally significant (−.003, $SE = .002$, $p = .10$, 95% CI = −.007–.000) (see Table 2).

Discussion

The purpose of the present paper was to test the motivational determinants and consequences of CBs in weight-loss dieting. Findings showed that being on a diet for more autonomous reasons was associated with a lower endorsement of dieting CBs. In turn, holding more dieting CBs was related to lower adherence to self-set dieting rules 2 months later, which, itself, negatively predicted weight-loss success.

The present findings thus point to an important psychological process, namely the use of CBs, which can in some measure explain how autonomous motivation is related to goal success. In line with the assumption proposed by Rabiau et al. (2006) in their integration of the compensatory beliefs model with SDT, it was demonstrated that autonomous motivation was negatively related to CBs activation. These results highlight that the autonomous motivation associated with goal-directed behaviors has important implications for one's capacity to resist counterproductive desires when dealing with temptations that challenge one's long-term goals. In addition, these findings corroborate prior work on autonomous motivation and its outcomes. Past research (e.g., Ryan, Plant, & O'Malley, 1995; Ryan, Sheldon, Kasser, & Deci, 1996; Sheldon & Elliot, 1998) has shown that autonomous motivation was related to greater persistence, commitment, and sustained efforts in the face of challenges (in the present study, challenge corresponds to the temptation to consume extra calories in spite of being on a diet).

The present findings also revealed that CBs lead to lower goal attainment (i.e., weight-loss success) by means of lower adherence or persistence at behaviors required to achieve self-set goals (i.e., adherence to self-set dieting rules). In other words, activating a dieting CBs disrupts dieting adherence, which lowers weight-loss success. These results corroborate prior work on CBs and goal adherence (Kronick et al., 2011; Rabiau et al., 2009). Thus, as suggested by the compensatory beliefs model (Knäuper et al., 2004; Rabiau et al., 2006), CBs are used as a "way out" of investing efforts towards the goal. As mentioned earlier, while carrying out the intended compensatory behaviors (i.e., the translation of the compensatory belief into action) could in principle make up for the temporary lack of adherence to one's goal (e.g., the calories consumed in a piece of cake could be burned off by exercising long enough afterwards), such behaviors are oftentimes not carried out due to obstacles that hinder translation of the intention into action (e.g., a lack of time to go to the gym), and as such, the goal-discrepant behavior (i.e., eating the piece of cake) is often not balanced out by a compensatory behavior (e.g., exercising), resulting in lower goal attainment (e.g., less weight loss).

In sum, we believe that most dieting CBs should have the potential to compensate, until a certain extent, for the former negative behavior (e.g., the calories consumed in a piece of cake) when the compensatory behavior (e.g., exercising) associated with them is performed. Consequently, if the compensatory behavior coupled with the dieting CBs is carried out, dieters are more likely to lose weight than if this compensatory behavior is not executed. Nevertheless, we consider that if a dieting CBs is fairly erroneous or invalid (e.g., someone is not sweetening his/her coffee in order to compensate for the dessert he/she just ate), it will not enhance the chances that individuals lose weight even if it get done (or in other words, even if the compensatory behavior associated with it is performed). Thus, despite substantial cognitive and behavioral efforts, dieters will not be more likely to lose weight. Given that compensatory behaviors were not assessed in the present study, future research should measure the extent to which these behaviors are carried out, so as to see if executing a compensatory behavior associated with a "more valid" dieting CBs facilitates weight-loss while this is not true for a compensatory behavior associated with a "less valid" dieting CBs.

Limitations of the present study include that it used a correlational design and that the data collected (especially weight), came from self-report measures. Dieters could have misreported their weight, particularly at follow-up, and this might have led to an overall overestimation of weight-loss. Therefore, weight loss success should be directly measured in future research by weighing people at Time 1 and again at Time 3.

Our findings also revealed that the mean of CBs was relatively low (.7), indicating a low overall endorsement of dieting CBs. These results may reflect the specific response format that was used for this study to assess compensatory beliefs, namely 0–4 scale ranging from "no truth at all" to "quite a bit of truth". The response options may have overly suggested to participants the possibility that the beliefs are irrational or untrue. Therefore, the response format of the scale has since been changed to a "disagree–agree" format (e.g., Radtke et al., 2011a).

Another important limitation of this study regards the measure of dieting adherence. Dieting adherence was assessed by the extent to which participants use the same rules over the 2-month period indicated by writing down the same rules at T1 and at T3. Thus, dieters who used most or all of the same dieting rules from beginning to end of their diet received the highest scores on dieting adherence. Although this measure partially relies on participants' recall of their rules at T3 (and thus involves a reliance on memory), it stills reflect adherence given that participants who do not remember their dieting rules at T3 have most likely not followed them cautiously. Moreover, although it is possible that some participants received a low score on dieting adherence because they changed their initial and non-effective dieting rules for more adaptive ones during the course of their diet, the significant and negative correlation between dieting adherence and T3 weight suggests that participants who reported the same dieting rules at T1 and T3 lost more weight and not the opposite. It is of course conceivable that there is a proportion of participants who adaptively changed their dieting rules and lost weight, artificially lowering the correlation. The sizeable and negative correlation ($r = -.41$, $p < .001$) between dieting adherence and T3 weight is thus a conservative estimate of the relationship between dieting adherence and weight loss.

Nevertheless, the relatively small effect of dieting adherence on Time 3 weight ($\beta = -.05$) could be explained by the limitations of the dieting adherence measure discussed above. As mentioned, some adaptive changes in dieting rules might have led to successful weight loss, but the way we measured dieting adherence (i.e., degree of overlap between rules used at T1 and T3) could not capture such beneficial changes in dieting rules over time.

Another limitation of the present study is that the sample is not representative of dieters in general and future research has to show how the findings generalize to broader samples, such as the male population and older populations, non-student samples, and to longer follow-up periods. Finally, it is also important to note that short-term dieting is likely to fire back in terms of risking weight regain after the diet (Hill, Thompson, & Wyatt, 2005). Therefore, in terms of promoting health behavior change and identifying mechanisms that might hinder attaining attractive health goals, adhering to a balanced diet (mostly to prevent weight gain) rather than dieting (mostly to lose weight) should be focused on in future research.

Implications include that health care professionals and others who assist individuals in reaching dieting goals should try to lead dieters to more self-determined dieting motives in order to guide them to successful weight-loss. Indeed, results suggest that interventions aimed at adaptive weight loss strategies need to consider the development of autonomous motivation. Thus, examining the predisposition of using autonomous versus controlling reasons in dieting behavior would be a step forward from the current study. Moreover, by specifically highlighting the role of CBs in weight-loss dieting, this study draws attention to an insidious cognitive strategy used by dieters. While CBs may provide individuals with a valid license for indulgence, if the CBs prescribed are not coupled with implementation strategies, they may be responsible for sabotaging successful goal attainment. Dieters should be more aware of their tendency to forming CBs and recognize how these maladaptive thoughts need to be coupled with robust implementation strategies. Since many studies have demonstrated the efficacy of cognitive behavioral therapy (CBT) at restructuring maladaptive or dysfunctional beliefs, specifically targeting dieting CBs through cognitive restructuring could be helpful for nutritionists, dietitians or other weight-loss professionals.

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