Adaptive and maladaptive emotion regulation skills are associated with food intake following a hunger-induced increase in negative emotions

Ackermans, Mégane; Jonker, Nienke; de Jong, Peter

Published in:
Appetite

DOI:
10.1016/j.appet.2023.107148

Appetite 193 (2024) 107148

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Adaptive and maladaptive emotion regulation skills are associated with food intake following a hunger-induced increase in negative emotions

Mégane Ackermans *, Nienke Jonker, Peter de Jong

University of Groningen, Department of Clinical Psychology and Experimental Psychopathology, Grote Kruisstraat 2/1, 9712 TS, Groningen, the Netherlands

ARTICLE INFO

Keywords:
Hunger
Emotions
Emotion regulation
Healthy weight
Food intake

ABSTRACT

Many individuals would like to lose weight and often attempt to do so by dieting. However, dieting attempts often backfire and contribute to the risk of weight gain and obesity. Food restriction inevitably leads to hunger and hunger, in turn, induces negative emotions. The inability to regulate such a hunger-induced increase in negative emotions in an adaptive way may be responsible for overeating. The current study aimed to gain a better understanding of this potential psychological mechanism underlying failed dieting attempts. Adaptive and maladaptive emotion regulation (ER) were assessed with an online questionnaire in women with a healthy weight. Subsequently, participants were assigned to the fasted condition (fasting for 14h, $n = 49$) or the satiated condition (eating between 2 h and 30 min before the lab session, $n = 59$) and attended a lab session in which they completed tasks while given the opportunity to eat chips and M&M's. We did not find an association between any ER variable and the likelihood to begin eating. Among those who began eating, higher scores on adaptive cognitive ER and on maladaptive behavioral ER were associated with lower caloric intake in fasted individuals. Higher scores on adaptive behavioral ER were associated with higher caloric intake in fasted individuals. Utilizing adaptive cognitive ER when experiencing a hunger-induced increase in negative emotions may help individuals manage their food intake and maintain a healthy weight.

1. Introduction

Many individuals would like to lose weight and often attempt to do so by dieting. One recent study across 30 countries found that globally, 45% of individuals are trying to lose weight, 44% of whom do so by dieting (i.e. restricting food intake; Ipsos, 2021). However, dieting attempts often backfire and contribute to the risk of weight gain and obesity (Siahpush et al., 2015). Given that losing weight requires eating less than one's body is accustomed to, food restriction inevitably leads to hunger (Zheng et al., 2009). Hunger, in turn, has been shown to increase negative emotions (specifically tension, anger, fatigue and confusion; Ackermans et al., 2022). From a theoretical perspective, these negative emotions would, in turn, lead to increased food intake. Indeed, theories suggest that eating can decrease negative emotions by providing comfort or distraction (Crockett et al., 2015) and that such eating in response to negative emotions is then negatively reinforced by the alleviation of negative emotions and positively reinforced by the inherently rewarding properties of food (Crocket et al., 2015; Klatzkin et al., 2022; Parker et al., 2006). Empirical research, however, has shown great variability regarding individuals' eating behavior following negative emotions. That is, eating has been found to increase, decrease, or remain unchanged following negative emotions (Macht, 2008). Given the variability of these findings, it is possible that the emotion itself does not lead to overeating. Rather, the inability to regulate negative emotions in an adaptive way may be responsible for overeating (Evers et al., 2010).

The ability to regulate emotions, also known as emotion regulation (ER), may play a crucial role in the relationship between emotions and food intake. ER can be defined as 'processes used to manage and change if, when, and how (e.g., how intensely) one experiences emotions and emotion-related motivational and physiological states, as well as how emotions are expressed behaviorally' (Eisenberg et al., 2010, p. 495). ER has proven critical to physical and mental health (Gross, 2014). Particular types of ER strategies (e.g., suppression) are generally considered as maladaptive because they have been consistently associated with a variety of psychological problems such as depression, anxiety, borderline personality disorder, substance abuse and eating disorders (Aldao et al., 2010). Maladaptive ER strategies have also been found to be implicated in problematic eating behaviors (e.g. Spoor et al.,

* Corresponding author.
E-mail addresses: m.a.m.ackermans@rug.nl (M. Ackermans), n.c.jonker@rug.nl (N. Jonker), p.j.de.jong@rug.nl (P. de Jong).

https://doi.org/10.1016/j.appet.2023.107148
Received 21 April 2023; Received in revised form 30 October 2023; Accepted 27 November 2023
Available online 30 November 2023

2007; Freeman & Gil, 2004). In addition to the presence of maladaptive strategies, a lack of adaptive ER strategies (e.g., reappraisal), may lead individuals to turn to eating as a means to regulate their emotions as a strategy they do have access to (Evers et al., 2010).

Despite the evidence of poor regulation of negative emotions leading to problematic eating behavior, little is known about the regulation of negative emotions specifically caused by hunger (Ackermans et al., 2022). Nonetheless, dieting individuals in particular may regularly experience such a hunger-induced increase in negative emotions, and given that a poor regulation of negative emotions, in turn, may lead to overeating (Evers et al., 2010), this may help explain why many dieting attempts fail. To better understand this mechanism, it is important to specifically study hunger-induced increases in negative emotions when determining the relationship between ER and eating.

Although no study has tested the association between ER and food intake following a hunger-induced increase in negative emotions, some studies have tested the effect of maladaptive and adaptive ER in response to negative emotions (unrelated to hunger) on food intake. Some studies found that suppression (a maladaptive strategy) following the induction of negative emotions with a recall procedure (individuals with obesity excluded; Evers et al., 2010) or a video clip (Vohs & Heatherton, 2000) was associated with increased food intake. In contrast, one study inducing negative emotions with a video clip in individuals with a healthy weight found that an instructed suppression group and a no-ER-instruction control group were equally likely to begin eating and ate equal amounts if they began eating (Taut et al., 2012). Regarding adaptive strategies, the study found that reappraisal instructions led to a smaller likelihood to begin eating than suppression or no ER instructions (but no difference in intake in those who began eating; Taut et al., 2012). In contrast, other studies found no effect of reappraisal on food intake (Evers et al., 2010). Thus, although some studies point towards adaptive ER decreasing and maladaptive ER increasing food intake, other studies found no association. However, previous studies have some important limitations that may explain these apparently inconsistent findings.

First, the studies only assessed suppression and/or reappraisal, rather than a wider range of ER strategies. However, ER is a multidimensional construct (Sörman et al., 2022) and encompasses a multitude of strategies. Specifically, both cognitions and behaviors play an important role in the regulation of emotions (Kraaij & Garnefski, 2019). According to Garnefski et al. (2001, p. 1313) 'thinking and acting are different processes used at different points in time' and cognitive and behavioral ER should therefore each be assessed separately. Moreover, reappraisal is an adaptive (cognitive) strategy and suppression is a maladaptive (behavioral) strategy (Gross & John, 2003). As such, the assessment of these two strategies conflates the type of strategy (i.e. cognitive vs. behavioral) with its adaptive value (i.e. adaptive vs. maladaptive). Additionally, assessing only these two strategies excludes a wide range of other strategies. The current study therefore separately assessed multiple cognitive and behavioral ER strategies in order to provide more insight into their unique or overlapping effects on eating following negative emotions.

A second limitation of most previous studies is that they used a bogus taste test in which participants were instructed to eat various foods and rate their taste and perception (Evers et al., 2010) or a forced choice paradigm in which participants chose either a healthy or an unhealthy granola bar (Mantau et al., 2018). These paradigms require participants to eat. However, they do not allow one to measure whether an individual started to eat in the first place. This constitutes a limitation regarding external validity given that, in real life, an individual can decide whether to begin eating in response to emotions. Individuals with adaptive ER skills may not need to turn to food as an ER strategy and only those with less adaptive ER may revert to the secondary strategy of (over)eating. It is therefore important not only to assess how much a person eats, but also whether they choose to eat in the first place. The aforementioned study by Taut et al. (2012) used a non-forced eating paradigm to assess not only how much individuals ate, but also whether they began to eat. They found that although ER had an effect on whether participants ate (as discussed above), it did not affect how much participants ate if they began eating. As such, we similarly included an eating initiation measure in addition to a continuous measure of food intake in our design.

Our study addressed these two limitations and also used hunger to increase negative emotions in order to gain a better understanding of a potential psychological mechanism underlying failed dieting attempts and overeating. Specifically, the current study tested to what extent the effect of a hunger-induced increase in negative emotions on food intake was moderated by habitual ER in women with a healthy weight. We tested the hypothesis that more maladaptive ER and/or less adaptive ER would be associated with a greater likelihood to begin eating than less maladaptive and more adaptive ER, specifically in those experiencing a hunger-induced increase in negative emotions. Second, we tested the hypothesis that in those who began eating, maladaptive ER and/or less adaptive ER was associated with more kilocalories (kcal) consumed than less maladaptive and more adaptive ER, specifically in those experiencing a hunger-induced increase in negative emotions. Finally, the relationship between ER and eating may be different in individuals with a weight loss goal compared to those without. Being hungry for a study and being hungry because of a weight loss goal are not the same, and we therefore propose that having a stronger weight loss goal may also lead individuals to regulate a hunger-induced increase in negative emotions differently compared to a weaker weight loss goal, which may also differentially affect their subsequent food intake. Although previous studies have not specifically assessed a weight loss goal, a few have assessed the relationship between frequent fasting or restrained eating (i.e. intentions to restrict food intake in order to promote weight loss or prevent weight gain; Tuschl, 1990), ER, and food intake. One study found that individuals who frequently engaged in fasting had less effective ER than those who did not (Trompeter et al., 2021), and another found that the relationship between ER and eating was different in restrained compared to unrestrained eaters (although the study specifically assessed binge eating as an outcome measure rather than general food intake; Freeman & Gil, 2004). Therefore, as a subsidiary issue, we also explored whether the effect of a hunger-induced increase in negative emotions and ER on food intake differed depending on the extent to which participants had a weight loss goal.

2. Method

2.1. Participants

Participants were female first-year university students with a healthy weight (BMI 18.5–25.0). We only included women because they are more likely to diet (De Ridder et al., 2014; Wardle et al., 2006) and more likely to eat in response to emotions (Péneau et al., 2013) than men. A total of 140 students signed up for the study and 128 completed the entire study. Ten participants were excluded from the analyses because their BMI was above 25.0 and one was excluded because her BMI was below 18.5. Eight additional participants from the fasted group and one from the satiated group were excluded because they did not follow eating instructions, leading to a final sample size of 108. Participants had an average BMI of 22.0 ($SD = 1.66$).

2.2. Materials

2.2.1. Demographics

Participants were asked their age, nationality, native language, whether they were vegan/vegetarian and whether they typically ate breakfast.

2.2.2. Weight loss goal

To unobtrusively assess whether participants had a weight loss goal, they were asked to rate a list of goals they may want to achieve (e.g.

'*learn a new language*', '*reduce stress levels*', '*read more books*'), one of which was '*lose weight*'. Each goal was rated on a 7-point likert scale from 1 (*not at all important*) to 7 (*extremely important*). We assessed weight loss goals unobtrusively because we believed a specific questionnaire on weight loss could affect food intake in the lab and could reveal the purpose of the study.

2.2.3. Behavioral emotion regulation

Behavioral ER was measured with the Behavioral Emotion Regulation Questionnaire (BERQ; Kraaij & Garnefski, 2019). The BERQ is a 20-item questionnaire assessing behavioral ER strategies that can be used after the experience of a negative or unpleasant event. It contains five subscales each consisting of four items: Seeking Distraction (e.g. *I do other things to distract myself*), Withdrawal (e.g. *I isolate myself*), Actively Approaching (e.g. *I take action to deal with it*), Seeking Social Support (e.g. *I share my feelings with someone*), Ignoring (e.g. *I move on and pretend that nothing happened)*. Participants are asked to rate how often they use each behavior on a scale from 1 ([*almost*] *never*) to 5 ([*almost*] *always*). In the current study internal consistency ranged from good to excellent for all subscales: Seeking Distraction (Cronbach's alpha = .82), Withdrawal (Cronbach's alpha = .88), Actively Approaching (Cronbach's alpha = .91), Seeking Social Support (Cronbach's alpha = .92) and Ignoring (Cronbach's alpha = .89). The authors of the BERQ further divide the subscales into a class of theoretically more adaptive strategies and a class of theoretically more maladaptive strategies (Kraaij & Garnefski, 2019). As such, for the current analyses a total adaptive ER score was calculated by combining scores on Seeking Distraction, Actively Approaching and Seeking Social Support and a total maladaptive score was calculated by combining scores on Withdrawal and Ignoring (Kraaij & Garnefski, 2019). In the current study internal consistency was good for adaptive behavioral ER and for maladaptive behavioral ER (Cronbach's alpha = .83 and .85, respectively).

2.2.4. Cognitive emotion regulation

Cognitive ER was measured with the Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski et al., 2001). The CERQ is a 36-item questionnaire assessing cognitive ER strategies that may be used after the experience of a negative or unpleasant event. It contains nine subscales each consisting of four items: Self-blame (e.g. *I think that I am the one to blame for it*), Acceptance (e.g. *I think that I have to accept the situation*), Rumination (e.g. *I often think about how I feel about what I have experienced*), Positive Refocusing (e.g. *I think of nicer things than what I have experienced*), Refocus on Planning (e.g. *I think about how to change the situation*), Positive Reappraisal (e.g. *I think that I can learn something from the situation*), Putting into Perspective (e.g. *I tell myself that there are worse things in life*), Catastrophizing (e.g. *I keep thinking about how terrible it is what I have experienced*), Other-blame (e.g. *I feel that others are to blame for it*). Participants are asked to rate how often they use each cognition on a scale from 1 ([*almost*] *never*) to 5 ([*almost*] *always*). In the current study, internal consistency ranged from acceptable to good for all subscales: Self-blame (Cronbach's alpha = .85), Acceptance (Cronbach's alpha = .73), Rumination (Cronbach's alpha = .76), Positive Refocusing (Cronbach's alpha = .84), Refocus on Planning (Cronbach's alpha = .70), Positive Reappraisal (Cronbach's alpha = .80), Putting into Perspective (Cronbach's alpha = .78), Catastrophizing (Cronbach's alpha = .80) and Other-blame (Cronbach's alpha = .83). The subscales can be subsumed into a class of theoretically more adaptive strategies and a class of theoretically more maladaptive strategies (Garnefski et al., 2001). Therefore, similarly to previous research, a total adaptive ER score was calculated by combining scores on Acceptance, Refocus on Planning, Positive Refocusing, Positive Reappraisal, and Putting into Perspective and a total maladaptive score was calculated by combining scores on Self-blame, Other-blame, Rumination, and Catastrophizing (Vanderhasselt et al., 2014). In the current study internal consistency was good for both adaptive and maladaptive cognitive ER (Cronbach's alpha = .88 and .84, respectively).

2.2.5. Hunger

Time since eating was assessed with the question '*How long has it been since you last ate?*' from the Hunger Scale (Grand, 1968). Subjective hunger was assessed with the question *'How hungry are you right now?'* from the Hunger Scale on a scale from 1 (*not at all*) to 7 (*extremely*).

2.2.6. Positive and negative emotions

Positive and negative emotions were measured with the Profile of Mood States (POMS; Grove & Prapavessis, 1992). The POMS consists of 40 emotions and participants rate to what extent each of them applies to them right now from 1 (*Not at all*) to 5 (*Extremely*). The POMS consists of five negative emotion subscales and two positive emotion subscales and internal consistency ranged from acceptable to good for the current study: Tension (6 items, e.g. *'tense'* and '*on-edge*'; Cronbach's alpha = .88), Anger (6 items, e.g. *'angry'* and *'annoyed'*; Cronbach's alpha = .81), Fatigue (5 items, e.g. *'fatigued'* and *'exhausted'*; Cronbach's alpha = .84), Depression (7 items, e.g. *'hopeless'* and *'miserable'*; Cronbach's alpha = .87), Confusion (5 items, e.g. *'confused'* and *'unable to concentrate'*; Cronbach's alpha = .75), Esteem-related affect (6 items, e.g. *'proud'* and *'confident'*; Cronbach's alpha = .74, Vigour (5 items, e.g. *'lively'* and *'energetic'*; Cronbach's alpha = .84). We calculated a score for each emotion by averaging the items of each subscale.

2.2.7. Food intake

We used two food intake outcome measures: eating initiation (i.e. whether an individual began to eat) and a continuous measure of food intake (i.e. how many kcal an individual consumed). The weight of food consumed (chips and M&M's) was calculated by subtracting the weight of the food after the experiment from the weight before the experiment. The consumed grams of chips and M&M's were converted into kcal and the sum of the kcal consumed in chips and in M&M's were added for a total measure of caloric intake (Evers et al., 2013). If less than 2 g of both foods had been consumed it was considered that the participant had not begun eating (due to measurement error of the food scale).

2.3. Procedure

This study was approved by the Ethics Committee of Psychology of the University of Groningen (PSY-2122-S-0076) and preregistered (https://aspredicted.org/QTG_X96). Participants were recruited via the online study participant platform for first-year university students (SONA). They were told the study was about the effect of hunger on emotions and attention. Participants received course credits for their participation.

2.3.1. Online session

Participants who signed up for the study participated in a Google Meet session with a researcher. During the session they received a Qualtrics link with the study information, the informed consent, the goals questionnaire, the BERQ and the CERQ. After completing the questionnaires, the researcher told them to which group they were assigned and gave them the corresponding instructions. The fasted group was told not to eat for 14 h before the lab session (Ackermans et al., 2022) and the satiated group was told to eat sometime between 2 h and half an hour before the lab session. All participants were asked to refrain from alcohol for 24 h. Finally, a time for the lab session was scheduled. The online session lasted approximately 20 min.

2.3.2. Lab session

The lab session was scheduled an average of 11 days (*SD* = 10.2) after the online session. The lab sessions took place anytime between 9.00h and 16.00h. In the lab, participants were seated behind a computer and completed the POMS and the two questions from the Hunger Scale. They then completed the attentional network task (Fan et al., 2002) and the stop-signal task (Logan et al., 1984), which were used as part of the cover story that we were interested in the effect of hunger on attention, but whose outcome was not relevant for the current study. They were subsequently brought to a different room and seated behind the computer, where a bag of chips and a bag of M&M's were already on the table. These bags had been pre-weighed such that each participant received 150 g of M&M's and 50 g of chips. As the researcher poured the contents of the bags into two bowls, she said: '*We know it's taking a long time and can be a bit boring, so to compensate a little, we have some snacks for you. The part about being in the hunger group or the satiated group only mattered for the first part of the study but it doesn't matter for this anymore, so you can just have as much as you want.*' They were also told that the researcher would come get them in 25 min (to ensure everyone was in the presence of the food for the same amount of time). The researcher then left the room and the participants completed filler tasks to give them time to eat (the Reward and Punishment Responsivity and Motivation Questionnaire [Jonker et al., 2022], a neutral video clip followed by questions about the video clip and the Tridimensional Personality Questionnaire [Cloninger et al., 1991]). After 25 min, the researcher returned and measured the participants' height and weight. After the participant left, the food was weighed again. After data collection was completed, participants were debriefed via email and the purpose of the study was explained.

2.4. Statistical analyses

To assess whether participants followed instructions, an independent samples *t*-test was performed with fasting condition (fasted vs. satiated) as predictor variable and Time since Eating as outcome variable. To assess the difference in subjective hunger between the groups, an independent samples *t*-test was performed with fasting condition as predictor variable and Subjective Hunger as outcome variable. To test whether the fasting manipulation led to increased negative emotions, a MANOVA was conducted with fasting condition as predictor and the five negative emotion subscales of the POMS as outcome variables (Tension, Anger, Fatigue, Depression, and Confusion). To test whether fasting led to decreased positive emotions, a MANOVA was conducted with fasting condition as predictor and the two positive emotion subscales of the POMS as outcome variables (Esteem-Related Affect and Vigour).

For the following analyses, adaptive and maladaptive CERQ and BERQ scores were centered. To test the first hypothesis, i.e. whether (adaptive and maladaptive) ER was associated with eating initiation following a hunger-induced increase in negative emotions we first conducted a logistic regression with adaptive CERQ score, adaptive BERQ score, fasting condition, and their interactions as predictors of eating initiation (eating vs. non-eating). We were interested in adaptive CERQ x fasting condition and adaptive BERQ x fasting condition to test the effect of adaptive cognitive and behavioral ER, respectively, in those with a hunger-induced increase in negative emotions. Second, we conducted the same analyses with the maladaptive CERQ and BERQ scores to test the effect of maladaptive ER.

To test the second hypothesis, i.e. whether (maladaptive and adaptive) ER was associated with kcal consumed in those who started eating, we first selected only the participants who had started eating. We then conducted a hierarchical linear regression with adaptive CERQ score, adaptive BERQ score and fasting condition as step 1 predictors and their interactions as step 2 predictors of food intake. We were interested in adaptive CERQ x fasting condition and adaptive BERQ x fasting condition to test the effect of adaptive cognitive and behavioral ER, respectively, in those with a hunger-induced increase in negative emotions. Significant interactions were followed up with linear regressions in each group. Second, we conducted the same analyses with the maladaptive CERQ and BERQ scores to test the effect of maladaptive ER. The regression analyses mentioned above differ from those described in the preregistration, in which we planned separate models for cognitive and behavioral ER, rather than adaptive and maladaptive ER. However, upon further reflection, we realized it made more sense to create models according to adaptive and maladaptive ER, as this is in direct relation to our hypotheses, whereas the cognitive/behavioral nature of the ER strategies is of secondary interest. The results of the preregistered analyses can be found in the supplementary materials.

For the MANOVA of the effect of fasting on negative emotions (manipulation check) we required 61 participants per condition (122 in total) to find a medium effect with a power of .80 and an α of 0.05. We used the manipulation check to calculate sample size because our main analyses required fewer participants. We recruited 130 participants to account for students with a BMI outside the healthy range and those not following eating instructions and after excluding these participants, our final sample size was 108. Using this sample size, we conducted a sensitivity analysis for the main analyses. For the logistic regressions with a power of .80 and an α of 0.05, we could detect odds ratios greater than 1.7. For the hierarchical linear regressions with a power of .80 and an α of 0.05 we could detect an effect size of 0.09 (small). Assumptions were tested and reported upon if violated.

3. Results

3.1. Descriptive statistics and manipulation check

Participants had a mean BMI of 21.99 (SD = 1.66, range = 18.87–24.93). Most participants (79%) were aged 18-21 and 19% of participants were over 21 years old.[1] Of the 49 participants in the fasted condition, 42 participants (86%) began eating and of the 59 participants in the satiated condition, 46 (78%) began eating. Of those who began eating, those in the fasted condition consumed an average of 342 kcal (220 kcal M&M's and 122 kcal chips) and those in the satiated condition consumed an average of 196 kcal (112 kcal M&M's and 84 kcal chips). The mean CERQ adaptive score was 3.17 (SD = 0.58); the mean CERQ maladaptive score was 2.41 (SD = 0. 52); the mean BERQ adaptive score was 3.22 (SD = 0.64) and the mean BERQ maladaptive was 2.30 (SD = 0.77). The fasted group went a longer time since eating, experienced more hunger and consumed more kcal than the satiated group. Moreover, the fasted group scored higher on negative emotions and lower on positive emotions than the satiated group. The groups did not differ on weight loss goal. These results are shown in Table 1. When asked about the true purpose of the study, 19 participants (18%) guessed that the food was of interest to the study, with most expressing a vague idea such as '*I think the food had something to do with it.*'

3.2. Is ER associated with eating initiation and does this differ according to fasting condition?

The logistic regression models for eating initiation as predicted by adaptive and maladaptive ER are shown in Tables 2 and 3, respectively. Neither fasting condition nor adaptive or maladaptive cognitive or behavioral ER nor their interactions were associated with eating initiation.

In addition to the main analyses with overall adaptive and maladaptive ER scores, we explored the effect of *individual* adaptive and maladaptive ER strategies on eating initiation (not preregistered). As such, each CERQ and BERQ adaptive subscale was entered into a logistic regression and each CERQ and BERQ maladaptive subscale was entered into a separate logistic regression. Only significant results are reported. Of the eight adaptive subscales, Acceptance was associated with an increased likelihood of choosing to eat. Of the six maladaptive strategies, the effect of Ignoring on eating initiation was different between the groups (i.e. the interaction was significant) but follow-up analyses did not show a significant association between Ignoring and eating initiation in either group.

[1] Age was a multiple choice question with the choices *18, 19, 20, 21* and *over 21*. Three participants did not complete the age question.

Table 1
Group Differences in Time Since Eating, Hunger, Emotions and Weight Loss Goal.

	Fasted (n = 49)		Satiated (n = 59)		Test statistic	p	Effect size
	M	*SD*	*M*	*SD*			
Time since eaten (min)	918.1	86.8	48.6	30.9	$t(106) = 24.0$	<.001	13.9 (Cohen's d)
Hunger	4.8	1.4	1.6	0.6	$t(106) = 15.2$	<.001	2.9 (Cohen's d)
Negative emotions	0.82	0.51	0.51	0.40	$F(5,102) = 5.2$	<.001	0.2 (η_p^2)
Positive emotions	1.58	0.56	1.98	0.54	$F(2,105) = 7.0$	<.001	0.12 (η_p^2)
Weight loss goal[a]	3.45	2.04	3.32	1.98	$t(106) = 0.33$	.69	0.06 (Cohen's d)
Food intake (kcal)[a]	294.0	193.9	153.3	134.2	t(106) = 4.44	<.001	0.86 (Cohen's d)

[a] These analyses were exploratory (not preregistered).

Table 2
Logistic Regression for the Effect of Fasting Condition and Adaptive ER on Eating Initiation.

	B	*SE*	Wald χ2	*p*	*OR*
Constant	1.250	0.326	14.660	<.001	3.491
Fasting condition	0.532	0.531	1.003	.317	1.703
CERQ adaptive	0.268	0.628	0.183	.669	1.308
BERQ adaptive	0.779	0.570	1.864	.172	2.178
Fasting condition × CERQ adaptive	−0.645	1.099	0.344	.557	0.525
Fasting condition × BERQ adaptive	−0.684	1.042	0.431	.511	0.505

Note. $n = 108$.

Table 3
Logistic Regression for the Effect of Fasting Condition and Maladaptive ER on Eating Initiation.

	B	*SE*	Wald χ2	*p*	*OR*
Constant	1.343	0.334	16.110	<.001	3.829
Fasting condition	0.658	0.591	1.238	.266	1.931
CERQ maladaptive	0.651	0.685	0.903	.342	1.917
BERQ maladaptive	0.153	0.455	0.113	.737	1.165
Fasting condition × CERQ maladaptive	−1.479	1.098	1.814	.178	0.228
Fasting condition × BERQ maladaptive	−0.631	0.729	0.750	.386	0.532

Note. $n = 108$.

3.3. *Is ER associated with food intake in those who begin eating and does this differ according to fasting condition?*

The hierarchical linear models for food intake as predicted by adaptive ER are shown in Table 4. Model 1 explained 20% ($F = 8.125$, $p < .001$) of the variance in caloric intake. Caloric intake was predicted by fasting condition such that (among those who began eating) the fasted condition consumed more kcal than the satiated condition. Cognitive and behavioral ER alone did not predict food intake. Adding the interactions (model 2) significantly added predictive value and model 2 explained 35% ($F = 10.285$, $p < .001$) of the variance in caloric intake. Food intake was significantly predicted by fasting condition and by interactions between fasting condition and adaptive cognitive ER and fasting condition and adaptive behavioral ER. Follow-up analyses in each group are shown in Table 5 and graphically displayed in Figs. 1 and 2. In the fasted condition, a higher score on cognitive adaptive ER was associated with a *lower* caloric consumption. Specifically, in the fasted group a one-point increase in adaptive CERQ score was associated with a decreased intake of 127 kcal [95% CI: 35-220]. In contrast, a higher score on behavioral adaptive ER was associated with an *increased* caloric consumption. Specifically, in the fasted group a one-point increase in adaptive BERQ score was associated with an increased intake of 193 kcal [95% CI: 101-286].

With the aim of revealing which ER strategies may be responsible for these effects, we conducted (non-preregistered) exploratory analyses with each adaptive BERQ and CERQ subscale. Only significant results are reported.Of the eight adaptive ER strategies, Acceptance was associated with greater food intake in the satiated group and lower food intake in the fasted group. In the fasted group but not in the satiated group, Positive Refocusing was associated with lower food intake and Seeking Social Support and Distraction were associated with greater food intake.

The hierarchical linear models for food intake as predicted by maladaptive ER are shown in Table 6. Model 1 explained 22% ($F = 8.924$, $p < .001$) of the variance in caloric intake. Adding the interactions (model 2) did not significantly explain additional variance ($F = 6.865$, $p = .050$). Food intake was significantly predicted by fasting condition and by an interaction between fasting condition and maladaptive behavioral ER. Follow-up analyses in each group are shown in Table 7 and graphically displayed in Fig. 3. In the fasted condition, a higher score on behavioral maladaptive ER was associated with a *lower* caloric consumption. Specifically, in the fasted group a one-point increase in maladaptive BERQ score was associated with a decreased intake of 76 kcal [95% CI: 12-141]. To explore the role of individual strategies, we conducted analyses with each maladaptive BERQ and CERQ subscale (not preregistered). Only significant results are reported. Of the six maladaptive ER strategies, only Self Blame was associated with less food

Table 4
Hierarchical Linear Regression for the Effect of Fasting Condition and Adaptive ER on Food Intake in those who Began Eating.

		B	*SE*	β	*t*	*p*	Adjusted R^2	F for change R^2	Sig. *F* change
Model 1	Constant	191.405	21.753	–	8.799	<.001	.197	8.125	<.001
	Fasting condition	155.366	32.168	.484*	4.830	<.001			
	CERQ adaptive	−18.423	31.774	−.064	−0.580	.564			
	BERQ adaptive	38.516	27.675	.156	1.392	.168			
Model 2	Constant	197.392	19.908	–	9.915	<.001	.348	10.709	<.001
	Fasting condition	164.554	29.068	.512*	5.661	<.001			
	CERQ adaptive	50.886	39.437	.177	1.290	.201			
	BERQ adaptive	−43.100	30.831	−.175	−1.398	.166			
	Fasting condition × CERQ adaptive	−178.251	57.941	−.436*	−3.076	.003			
	Fasting condition × BERQ adaptive	236.505	52.450	.586*	4.509	<.001			

Note. $n = 88$. *$p < .05$.

Table 5
Linear Regressions for the Effect of Adaptive ER on Food Intake per Fasting Condition.

	Fasted Condition (n = 42)					Satiated Condition (n = 46)				
	B	*SE*	β	*t*	*p*	*B*	*SE*	β	*t*	*p*
Constant	361.936	22.828	–	15.855	<.001	197.392	18.391	–	10.733	<.001
CERQ adaptive	−127.365	45.750	−.435*	−2.784	.008	50.886	36.432	.226	1.397	.170
BERQ adaptive	193.405	45.732	.660*	4.229	<.001	−43.100	28.482	−.245	−1.513	.138

Note. *$p < .05$.

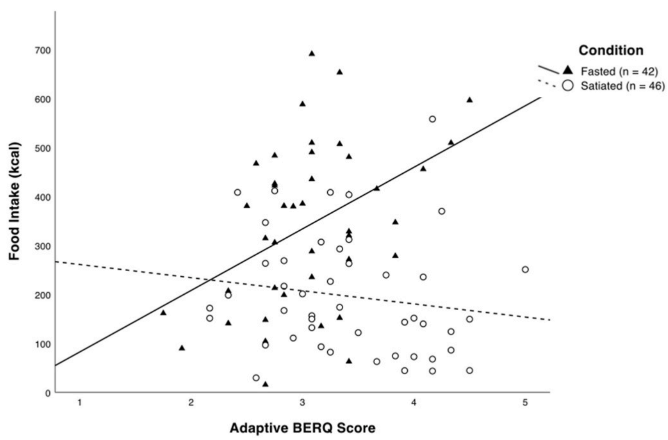

Fig. 1. Association between adaptive behavioral ER and food intake per fasting condition.

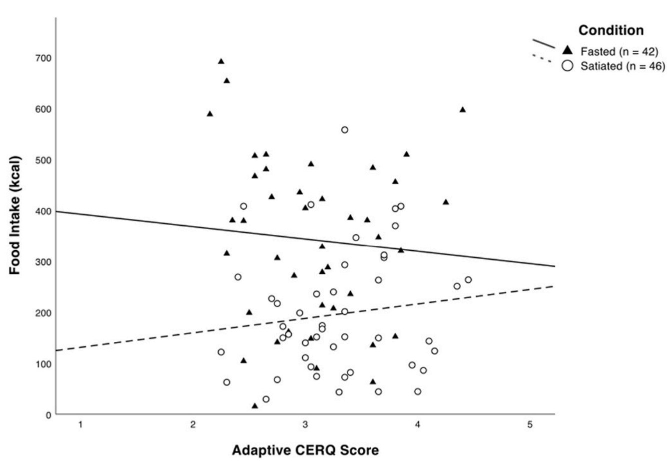

Fig. 2. Association between adaptive cognitive ER and food intake per fasting condition.

intake in the satiated but not the fasted group.

3.4. *Does the association between ER and eating initiation/food intake differ according to weight loss goal?*

Exploratory (non-preregistered) analyses were conducted to test whether the effect of ER on eating initiation and food intake differed in individuals with a weight loss goal. This was done by adding weight loss goal as a predictor to the previous logistic and hierarchical regressions, in addition to its interaction with fasting and ER and three-way interactions between weight loss goal, fasting and ER. We were interested in the three-way interactions. None of the three-way interactions were significant, suggesting there was no difference in the effect of ER on eating initiation or food intake depending on weight loss goal.

4. Discussion

The current study tested the association between habitual adaptive and maladaptive ER skills and food intake following a hunger-induced increase in negative emotions in a lab setting. We successfully increased hunger and negative emotions in the fasted group as indicated by the manipulation checks. We found that having fasted did not lead to a greater likelihood of choosing to eat than being satiated but did lead to greater food intake in those who began eating. Among those who began eating, higher scores on adaptive *cognitive* ER were associated with *lower* caloric intake in fasted individuals, which was in line with predictions. In contrast, higher scores on adaptive *behavioral* ER were associated with *higher* caloric intake in fasted individuals, which was contrary to predictions. Also contrary to predictions was the finding that *higher* maladaptive behavioral ER was associated with *lower* caloric intake in fasted individuals. Finally, we did not find an association between any ER variable and the likelihood to begin eating.

Adaptive cognitive ER being associated with decreased food intake in the fasted group was in line with expectations. A one point increase in CERQ score was associated with a 127 kcal decrease in food intake, which is an important finding given that a difference in 150 kcal per day has been estimated to correspond to a weight change of 11 kg over a one-year period (Rosenbaum & Leibel, 1998). Our finding fits with theoretical models of overeating: the psychosomatic theory as well as the affect regulation theory suggest individuals overeat in an attempt to decrease negative emotions (Hawkins & Clement, 1984; Kaplan &

Table 6
Hierarchical Linear Regression for the Effect of Fasting Condition and Maladaptive ER on Food Intake in those who Began Eating.

		B	*SE*	β	*t*	*p*	Adjusted R^2	*F* for Change R^2	Sig. *F* change
Model 1	Constant	194.033	21.113	–	9.190	<.001	.215	8.924	<.001
	Fasting condition	149.865	30.608	.467*	4.896	<.001			
	CERQ maladaptive	35.283	28.911	.118	1.220	.226			
	BERQ maladaptive	−35.047	20.148	−.169	−1.739	.086			
Model 2	Constant	195.945	20.628	–	9.499	<.001	.252	3.105	.050
	Fasting condition	150.197	29.870	.468*	5.028	<.001			
	CERQ maladaptive	−16.988	39.708	−.057	−.428	.670			
	BERQ maladaptive	4.058	26.986	.020	0.150	.881			
	Fasting condition × CERQ maladaptive	101.309	56.487	.236	1.793	.077			
	Fasting condition × BERQ maladaptive	−80.286	39.468	−.262*	−2.034	.045			

Note. n = 88. *$p < .05$.

Table 7
Linear Regressions for the Effect of Maladaptive ER on Food Intake per Fasting Condition.

	Fasted Condition (*n* = 42)					Satiated Condition (*n* = 46)				
	B	*SE*	β	*t*	*p*	*B*	*SE*	β	*t*	*p*
Constant	345.426	24.019	-	14.381	<.001	196.266	18.352	-	10.695	<.001
CERQ maladaptive	84.321	44.547	.278	1.893	.066	−16.988	35.335	−.075	−0.481	.633
BERQ maladaptive	−76.228	31.935	−.351*	−2.387	.022	4.058	24.014	.026	0.169	.867

Note. *p < .05.

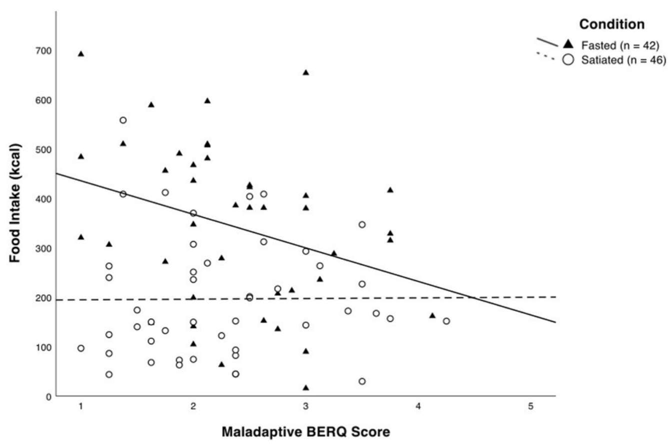

Fig. 3. Association between maladaptive behavioral ER and food intake per fasting condition.

Kaplan, 1957) and another theory suggests that negative emotions inhibit top-down control, which is needed to make healthy food choices (Brytek-Matera, 2021). If an individual has access to adaptive cognitive ER strategies to decrease negative emotions (Gross, 2002), they may be less likely to rely on food to alleviate these emotions. One potential reason why cognitive, but not behavioral, adaptive ER was associated with decreased food intake could be that cognitive strategies are deployed earlier than behavioral strategies (Gross, 2014), allowing the individual to downregulate negative emotions before they are fully activated, instead of turning to food.

Given that most previous research has assessed specific ER strategies rather than a broad range, and did not use hunger to increase negative emotions, we can only compare our findings to previous findings to a certain extent. Our findings regarding adaptive cognitive ER are in line with a questionnaire study that found that acceptance (an adaptive cognitive strategy) helped those with low craving control (i.e. low perceived level of control over resisting a food item; Dalton et al., 2015) decrease sweet food intake (Buckland et al., 2021). Moreover, our findings corroborate a study that found lower ER difficulties in general were associated with a greater ability to regulate overeating (Kerin et al., 2018). However, they contrast with a study that found no effect of instructed reappraisal (also an adaptive cognitive strategy) on food intake in those who began eating (Taut et al., 2012) and with another study that found that the adaptive cognitive strategy positive reframing had no effect on the relationship between craving control and food intake (Buckland et al., 2021). Finally, our lack of a relationship between adaptive cognitive ER and eating initiation contrasts with a previous finding that instructed reappraisal (an adaptive cognitive strategy) led to a smaller likelihood to begin eating than no instruction (Taut et al., 2012). The overall pattern of previous research is thus inconsistent, possibly due to the assessment of different ER strategies. We therefore cannot draw conclusions regarding the association between specific adaptive ER strategies and food intake. Our study does, however, suggest that adaptive cognitive ER may be beneficial to help manage food intake.

Adaptive behavioral ER being associated with increased food intake was contrary to predictions. One plausible explanation could be that the ER strategy of seeking social support was one of the subscales. Given that, in the lab setting, it was not possible to seek social support, those who typically rely on this strategy may have eaten more as an alternative strategy. Our exploratory analyses indeed provide evidence for increased food intake in those scoring high in seeking social support. A second possible explanation is that, given that negative emotions were induced with hunger in our study, the increased food intake following negative emotions was in fact adaptive because participants were hungry. Eating, in that case, could be considered an adaptive behavioral strategy used by those who typically use adaptive behavioral strategies to regulate emotions.

Maladaptive behavioral ER being associated with decreased food intake was contrary to predictions. We expected those high in maladaptive ER to turn to food as an alternative strategy to regulate negative emotions after the unsuccessful use of other (maladaptive) strategies. Although maladaptive ER has been linked to negative outcomes such as depression, anxiety and lower wellbeing (Gross & John, 2003; Kraaij & Garnefski, 2019), we did not find a similar link with (dysfunctional) eating behavior. Our findings contrast with a lab study using an ER manipulation that found no difference in eating initiation or food intake between instructed suppression (a maladaptive behavioral strategy) and no ER instruction (Taut et al., 2012) and with another lab study showing those regularly using suppression had greater food intake following a negative emotion induction than those who did not (Evers et al., 2010). One potential explanation for our results is that individuals may not apply the same ER strategies to a hunger-induced increase in negative emotions than to other negative emotions. That is, perhaps those who regularly use maladaptive ER did not apply maladaptive ER to their negative emotions in the lab, and therefore did not eat to regulate their emotions. Moreover, given that the lower bound of the confidence interval was only 12 kcal, we must be cautious not to overinterpret this finding and future research is needed to help determine whether the association between maladaptive ER and decreased food intake is robust.

Our study used fasting to induce negative emotions to mimic the experience of dieters who often experience hunger. However, being hungry in order to participate in a study and choosing to be hungry for a weight loss goal are different. We therefore explored the relationship between weight loss goal, ER and fasting on food intake and eating initiation. We did not find a different effect of ER and fasting on food intake or eating initiation depending on weight loss goal. However, it should be noted that our power calculations were not based on the inclusion of weight loss goal as a predictor in our models, so a potential interaction with ER cannot be excluded. Future research could specifically assess which factors, such as dieting, moderate the association between ER and food intake.

4.1. Limitations and strengths

A first limitation of our study was the ceiling effect of eating initiation; most participants ate and this may have left little variance to be explained by ER. Second, it should be noted that our power calculations were not based on analyses for individual strategies or for adding weight loss goal as a predictor to our analyses. Future research could test the effect of a multitude of individual ER strategies (beyond the typically studied suppression and reappraisal) on eating initiation and caloric intake and could specifically analyze the association between dieting, ER, and food intake.

Despite these limitations, our study also had several strengths. First, the lab setting allowed for an objective and accurate measure of caloric intake, unlike self-reported food intake which is often underreported (Macdiarmid & Blundell, 1998). Second, the inclusion of an eating initiation measure allowed us to establish whether eating was used as an ER strategy in the first place, unlike a forced eating paradigm (Taut et al., 2012). Third, the induction of negative emotions with fasting more closely represents the experience of individuals attempting to diet than a general negative emotion induction. This allows us to better understand potential mechanisms underlying failed dieting. A final strength is our assessment of a broad range of ER strategies. Past research has focused largely on the use of reappraisal and suppression (e.g. Evers et al., 2010; Taut et al., 2012) and to our knowledge, we are the first not only to assess a broad range of ER strategies but also to distinguish between the effects of behavioral and cognitive strategies on food intake.

4.2. Conclusion

Our study suggests that habitual ER was not associated with a person's inclination to start eating following the experience of negative emotions but was associated with how much a person eats if they begin eating. Eating in response to emotions has been deemed a critical factor underlying weight gain (Koenders & van Strien, 2011) and obesity (Ganley, 1989) and our study highlights that ER, specifically adaptive cognitive ER when experiencing a hunger-induced increase in negative emotions, may help individuals manage their food intake and maintain a healthy weight.

Ethical statement

This study was approved by the Ethics Committee of Psychology of the University of Groningen (PSY-2122-S-0076). All participants provided informed consent before participating in the study.

Funding

The first author was funded by the University of Groningen's PhD Scholarship Program issued by the Dutch Ministry of Education, Culture, and Science. The funding source had no involvement in the study design; in the collection, analysis and interpretation of data; in the writing of the report or in the decision to submit the article for publication.

Author contributions

M.A.: Conceptualization, methodology, formal analysis, investigation, data curation, writing - original draft preparation, visualisation, project administration, funding acquisition. N.C.: Conceptualization, methodology, formal analysis, writing - review & editing, supervision, funding acquisition. P.J.: Conceptualization, methodology, writing - review & editing, supervision, funding acquisition. All authors approved the final version of this article.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2023.107148.

References

Ackermans, M. A., Jonker, N. C., Bennik, E. C., & de Jong, P. J. (2022). Hunger increases negative and decreases positive emotions in women with a healthy weight. *Appetite, 168*. https://doi.org/10.1016/j.appet.2021.105746

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review, 30*(2), 217–237. https://doi.org/10.1016/j.cpr.2009.11.004

Brytek-Matera, A. (2021). Negative affect and maladaptive eating behavior as a regulation strategy in normal-weight individuals: A narrative review. *Sustainability (Switzerland, 13*(24). https://doi.org/10.3390/su132413704. MDPI.

Buckland, N. J., Swinnerton, L. F., Ng, K., Price, M., Wilkinson, L. L., Myers, A., & Dalton, M. (2021). Susceptibility to increased high energy dense sweet and savoury food intake in response to the COVID-19 lockdown: The role of craving control and acceptance coping strategies. *Appetite, 158*. https://doi.org/10.1016/j.appet.2020.105017

Cloninger, C. R., Przybeck, T. R., & Svrakic, D. M. (1991). The tridimensional personality questionnaire: U.S. Normative data. *Psychological Reports, 69*(3), 1047–1057. https://doi.org/10.2466/pr0.1991.69.3.1047

Crockett, A. C., Myhre, S. K., & Rokke, P. D. (2015). Boredom proneness and emotion regulation predict emotional eating. *Journal of Health Psychology, 20*(5), 670–680. https://doi.org/10.1177/1359105315573439

Dalton, M., Finlayson, G., Hill, A., & Blundell, J. (2015). Preliminary validation and principal components analysis of the Control of Eating Questionnaire (CoEQ) for the experience of food craving. *European Journal of Clinical Nutrition, 69*(12), 1313–1317. https://doi.org/10.1038/ejcn.2015.57

Eisenberg, N., Spinrad, T. L., & Eggum, N. D. (2010). Emotion-related self-regulation and its relation to children's maladjustment. *Annual Review of Clinical Psychology, 6*, 495–525. https://doi.org/10.1146/annurev.clinpsy.121208.131208

Evers, C., Adriaanse, M., de Ridder, D. T. D, & de Witt Huberts, J. C. (2013). Good mood food. Positive emotion as a neglected trigger for food intake. *Appetite, 68*, 1–7. https://doi.org/10.1016/j.appet.2013.04.007.

Evers, C., Stok, F., & de Ridder, D. T. D. (2010). Feeding your feelings: Emotion regulation strategies and emotional eating. *Personality and Social Psychology Bulletin, 36*(6), 792–804. https://doi.org/10.1177/0146167210371383

Fan, J., McCandliss, B. D., Sommer, T., Raz, A., & Posner, M. I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive Neuroscience, 14*(3), 340–347. https://doi.org/10.1162/089892902317361886

Freeman, L. M. Y., & Gil, K. M. (2004). Daily stress, coping, and dietary restraint in binge eating. *International Journal of Eating Disorders, 36*(2), 204–212. https://doi.org/10.1002/eat.20012

Ganley, R. M. (1989). Emotion and eating in obesity: A review of the literature. *International Journal of Eating Disorders, 8*(3), 343–361.

Garnefski, N., Kraaij, V., & Spinhoven, P. (2001). Negative life events, cognitive emotion regulation and emotional problems. *Personality and Individual Differences, 30*, 1311–1327.

Grand, S. (1968). Color-word interference: II. An investigation of the role of vocal conflict and hunger in associative priming. *Journal of Experimental Psychology, 77*, 31–40. https://doi.org/10.1037/h0025759

Gross, J. J. (2002). Emotion regulation: Affective, cognitive, and social consequences. *Psychophysiology, 39*, 281–289, 10.1017.S0048577201393198.

Gross, J. J. (2014). *Handbook of emotion regulation*. Guilford Publications.

Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology, 85*(2), 348–362. https://doi.org/10.1037/0022-3514.85.2.348

Grove, J. R., & Prapavessis, H. (1992). Preliminary evidence for the reliability and validity of an abbreviated Profile of Mood States. *International Journal of Sport Psychology, 23*, 93–109. https://doi.org/10.1037/1040-3590.7.1.80

Hawkins, R. C., & Clement, P. F. (1984). Binge eating: Measurement problems and a conceptual model. In R. C. Hawkins, W. J. Fremouw, & P. F. Clement (Eds.), *The binge purge syndrome: Diagnosis, treatment, and research* (pp. 229–251). Springer.

Ipsos. (2021). More than half of the global population would rather exercise more and/or eat more healthily, but not diet as actions they would take when trying to lose weight [Press release] https://www.ipsos.com/sites/default/files/ct/news/documents/2021-01/pr-global-weight-and-actions.pdf.

Jonker, N. C., Timmerman, M. E., & de Jong, P. J. (2022). The reward and punishment responsivity and motivation questionnaire (RPRM-Q): A stimulus-independent self-report measure of reward and punishment sensitivity that differentiates between responsivity and motivation. *Frontiers in Psychology, 13*. https://doi.org/10.3389/fpsyg.2022.929255

Kaplan, H. L., & Kaplan, H. S. (1957). The psychosomatic concept of obesity. *The Journal of Nervous and Mental Disease, 125*, 181–201.

Kerin, J. L., Webb, H. J., & Zimmer-Gembeck, M. J. (2018). Resisting the temptation of food: Regulating overeating and associations with emotion regulation, mindfulness, and eating pathology. *Australian Journal of Psychology, 70*(2), 167–178. https://doi.org/10.1111/ajpy.12169

Klatzkin, R. K., Nolan, L. J., & Kissileff, H. R. (2022). Self-reported emotional eaters consume more food under stress if they experience heightened stress reactivity and emotional relief from stress upon eating. *Physiology & Behavior, 243*. https://doi.org/10.1016/j.physbeh.2021.113638

Koenders, P. G., & van Strien, T. (2011). Emotional eating, rather than lifestyle behavior, drives weight gain in a prospective study in 1562 employees. *Journal of Occupational and Environmental Medicine, 53*(11), 1287–1293. https://doi.org/10.1097/JOM.0b013e31823078a2

Kraaij, V., & Garnefski, N. (2019). The behavioral emotion regulation questionnaire: Development, psychometric properties and relationships with emotional problems and the cognitive emotion regulation questionnaire. *Personality and Individual Differences, 137*, 56–61. https://doi.org/10.1016/j.paid.2018.07.036

Logan, G. D., Cowan, W. B., & Davis, K. A. (1984). On the ability to inhibit simple and choice reaction time responses: A model and a method. *Journal of Experimental Psychology: Human Perception and Performance, 10*(2), 276–291. https://doi.org/10.1037//0096-1523.10.2.276

Macdiarmid, J., & Blundell, J. (1998). Assessing dietary intake: Who, what and why of under-reporting. *Nutrition Research Reviews, 11*(2), 231–253. https://doi.org/10.1079/nrr19980017

Macht, M. (2008). How emotions affect eating: A five-way model. *Appetite, 50*(1), 1–11. https://doi.org/10.1016/j.appet.2007.07.002

Mantau, A., Hattula, S., & Bornemann, T. (2018). Individual determinants of emotional eating: A simultaneous investigation. *Appetite, 130*, 93–103. https://doi.org/10.1016/j.appet.2018.07.015

Parker, G., Parker, I., & Brotchie, H. (2006). Mood state effects of chocolate. *Journal of Affective Disorders, 92*(2–3), 149–159. https://doi.org/10.1016/j.jad.2006.02.007

Péneau, S., Ménard, E., Méjean, C., Bellisle, F., & Hercberg, S. (2013). Sex and dieting modify the association between emotional eating and weight status. *American Journal of Clinical Nutrition, 97*(6), 1307–1313. https://doi.org/10.3945/ajcn.112.054916

de Ridder, D., Adriaanse, M., Evers, C., & Verhoeven, A. (2014). Who diets? Most people and especially when they worry about food. *Appetite, 80*, 103–108. https://doi.org/10.1016/j.appet.2014.05.011

Rosenbaum, M., & Leibel, R. L. (1998). The physiology of body weight regulation: relevance to the etiology of obesity in children. *Pediatrics, 101*(3), 525–539.

Siahpush, M., Tibbits, M., Shaikh, R. A., Singh, G. K., Sikora Kessler, A., & Huang, T. T. K. (2015). Dieting increases the likelihood of subsequent obesity and BMI gain: Results from a prospective study of an Australian national sample. *International Journal of Behavioral Medicine, 22*(5), 662–671. https://doi.org/10.1007/s12529-015-9463-5

Sörman, K., Garke, M. A., Isacsson, N. H., Jangard, S., Bjureberg, J., Hellner, C., Sinha, R., & Jayaram-Lindström, N. (2022). Measures of emotion regulation: Convergence and psychometric properties of the difficulties in emotion regulation scale and emotion regulation questionnaire. *Journal of Clinical Psychology, 78*, 201–217. https://doi.org/10.1002/jclp.23206

Spoor, S. T. P., Bekker, M. H. J., van Strien, T., & van Heck, G. L. (2007). Relations between negative affect, coping, and emotional eating. *Appetite, 48*(3), 368–376. https://doi.org/10.1016/j.appet.2006.10.005

Taut, D., Renner, B., & Baban, A. (2012). Reappraise the situation but express your emotions: Impact of emotion regulation strategies on ad libitum food intake. *Frontiers in Psychology, 3*(SEP). https://doi.org/10.3389/fpsyg.2012.00359

Trompeter, N., Bussey, K., Forbes, M. K., Mond, J., Hay, P., Cunningham, M. L., & Mitchison, D. (2021). Emotion dysregulation across the span of eating disorder symptoms: Findings from a community sample of adolescents. *International Journal of Eating Disorders, 54*(11), 1946–1955. https://doi.org/10.1002/eat.23609

Vanderhasselt, M. A., Koster, E. H. W., Onraedt, T., Bruyneel, L., Goubert, L., & de Raedt, R. (2014). Adaptive cognitive emotion regulation moderates the relationship between dysfunctional attitudes and depressive symptoms during a stressful life period: A prospective study. *Journal of Behavior Therapy and Experimental Psychiatry, 45*(2), 291–296. https://doi.org/10.1016/j.jbtep.2014.01.003

Vohs, K. D., & Heatherton, T. F. (2000). Self-regulatory failure: A resource-depletion approach. *Psychological Science, 11*(3), 249–254. https://doi.org/10.1111/1467-9280.00250

Wardle, J., Haase, A. M., & Steptoe, A. (2006). Body image and weight control in young adults: International comparisons in university students from 22 countries. *International Journal of Obesity, 30*(4), 644–651. https://doi.org/10.1038/sj.ijo.0803050

Zheng, H., Lenard, N. R., Shin, A. C., & Berthoud, H. R. (2009). Appetite control and energy balance regulation in the modern world: Reward-driven brain overrides repletion signals. *International Journal of Obesity, 33*, S8–S13. https://doi.org/10.1038/ijo.2009.65