

Desire to eat and its relationship with emotion regulation, what does rumination has to do with it?

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Abstract

There seems to be an important relationship between type of emotion regulation, adaptive or maladaptive, and eating behaviour. The focus of the literature to date is mainly on reappraisal and suppression. This online study sought to extend the findings thus far to another maladaptive emotion regulation strategy, rumination. An autobiographical sadness-evoking event was recalled. Then participants were randomly allocated to a rumination condition to trigger maladaptive emotion regulation, or a reappraisal condition to trigger adaptive emotion regulation. Desire to eat was repeatedly measured at pre-recall, post-recall and post-emotion regulation. Findings revealed that desire to eat decreased after a sadness evoking event was recalled but remained untouched by the emotion regulation manipulation. The desire to eat was the same whether you ruminated or reappraised emotions. Findings are carefully interpreted in light of this study being the first to experimentally test the effect of rumination on desire to eat. More empirical evidence is necessary to make sound conclusions about the relationship between the maladaptive emotion regulation strategy rumination and eating behaviour.

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Introduction

Do you remember that movie scene where the movie star is eating whip cream from the spray can? Her boyfriend just broke up with her and eating is the only way she can deal with the emotions she is feeling. This is a perfect example of emotional eating. Emotional eating is formulated as the tendency to overeat in response to negative emotions, such as anxiety or irritability, rather than the feeling of being hungry (Van Strien, Frijters, & Bergers, 1986). It was previously thought that it was the mere experience of negative emotions that could lead to a change in eating behaviour (Cools, Schotte, & McNally, 1992; Ganley, 1989; Greeno & Wing, 1994). However, current research, has revealed that it is not the emotion per se that elicits a change in eating behaviour, rather it is about the way individuals regulate those emotions (Evers, Stok, & de Ridder, 2010; Spoor, Bekker, Strien, & Heck, 2006). As emotion regulation is importantly related to changes in eating behaviour, this study investigates the differential consequences adaptive and maladaptive emotion regulation strategies have on eating behaviour. More specifically, the main focus is on the frequently used emotion regulation strategy rumination. Rumination can be defined as persistent and repetitive thinking about negative emotions or events in a passive way (Aldao & Nolen-Hoeksema, 2010; Gross, 1999). To better understand the relation between rumination and eating behaviour, the relationship between emotions and eating behaviour will be discussed first, followed by the role of adaptive and maladaptive emotion regulation in general and in relation to eating behaviour.

Emotions and eating behaviour

Emotions are an integral part of being human and during the day the experience of positive and negative emotions alternate. Just as the type of emotion seems to be able to influence our eating behaviour, what we eat can influence our emotions just as well. An example is after having a good meal emotional experience tends to be more positive than

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negative (Macht, Haugt, & Salewsky, 2004). The way emotions influence eating behaviour depends on the type of emotion. In general, positive emotions lead to an increase in food intake (Cardi, Leppanen, & Treasure, 2015; Devonport, Nicholls, & Fullerton, 2019; Evers, Dingemans, Junghans, & Boevé, 2018). However, when it comes to negative emotions this relation seems to be more complicated. On the one hand, two meta-analyses revealed that only in people who restrain their eating, negative emotions lead to an increase in food intake (Cardi et al., 2015; Evers et al., 2018). Yet on the other hand, several studies were not able to replicate these findings (Chua, Touyz, & Hill, 2004; Lowe & Maycock, 1988). Additionally, a review of the literature revealed that normal, non-restrained eaters, equally increased and decreased their food intake (Macht, 2008). To date it remains unclear which biological and psychological mechanisms are responsible for these contradictory findings.

Several theories have proposed different mechanisms explaining how negative emotions can alter eating behaviour. From a biological perspective, negative emotions can decrease food intake as emotions activate the autonomic nervous system. This system prepares the body to fight or flight. Physiological reactions supporting this reaction are increased heart rate and suppressed metabolism (Torres & Newsom, 2007; Wing, Blair, Epstein, & McDermott, 1990). One of the body's responses to a stressful event, such as negative emotions, is to release corticotropin-releasing hormone (CRH) into the bloodstream. After which CRH has a cascading effect in the body that ultimately leads to the inhibition of appetite (Heinrichs & Richard, 1999; Richard, Lin, & Timofeeva, 2002).

From a psychological perspective, however, it is proposed that people who attempt to influence their weight by restricting their food intake might have difficulties with inhibition (Polivy & Herman, 1999). According to restraint theory (Herman & Polivy, 1980; Greeno & Wing, 1994) people who restrain their eating become more vulnerable to lose control over their food intake after experiencing negative affect. Indeed, under stress or when confronted

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with comfort food restrained eaters tend to overeat (Polivy & Herman, 1999). Furthermore, only people who restrain their eating do negative emotions lead to increased food intake (Cardi et al., 2015; Evers et al., 2018).

Another possible mechanism is posited by escape theory, proposing that when people are confronted with ego-threatening information eating can be used as an attempt to escape from the uncomfortable feelings (Heatherton & Baumeister, 1991). In line with this, Wallis and Hetherington (2004) found that ego-threatening negative affect and scoring high on self-awareness contributes to increased food intake. Moreover, Shafran, Lee, Cooper, Palmer and Fairburn (2007) found an attentional bias towards binge-like foods in eating disordered women.

A commonality between these theories is that overeating only takes place if the first strategy employed is not successful at changing the negative emotional experience. Then a second regulation strategy is necessary to deal with the emotion that is rather maladaptive, namely eating. This suggests that it is not the emotion per se that causes a change in eating behaviour, rather it depends on the unavailability of adaptive emotion regulation strategies.

Emotion regulation

Emotion regulation is the influence people exert to the experience and expression of their emotions (Gross, 1999). Difficulties in emotion regulation can be due to the use of maladaptive emotion regulation strategies instead of adaptive ones. Emotion regulation is adaptive when physiological reactions to negative affect are accurately detected and evaluated. This is followed by a regulation strategy that normalizes and influences the emotional response (Price & Hooven, 2018). An example of an adaptive emotion regulation strategy is cognitive reappraisal, the re-evaluation of emotions experienced (Gross, 1999). Reappraisal provides psychological distance from negative affect and is therefore seen as a 'cooling' strategy (Mischel & Ayduk, 2004). Furthermore, it is associated with less

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physiological activation in partners in social relationships, more experience of positive emotions, and decreased behavioural expression and emotional experience (Gross, 2002).

Contrary to adaptive emotion regulation, maladaptive emotion regulation happens when the strategy chosen does not lead to a modification of the affective response (Aldao & Nolen-Hoeksema, 2010). One of the maladaptive emotion regulation strategies is suppression, the inhibition of emotions experienced (Gross, 1999). This means that when in an emotional state, emotions are reduced or not expressed (Gross & John, 2003). Suppression is related to psychopathology (Aldao, & Hoeksema., 2010), disruption of communication (Butler, Egloff, Wilhelm, Smith, Erickson, & Gross , 2003), increased physiological responding in partners in social relationships, diminished memory and decreased behavioural expression, nonetheless it does not succeed at decreasing emotions experienced (Gross, 2002).

There is a third emotion regulation strategy that can be either adaptive or maladaptive, namely rumination. Rumination can be seen as adaptive when it is used as reflection, the deliberate turning inward to solve a current problem to alleviate one's negative emotions (Nolen-Hoeksema, Wisco, Lyubomirsky, 2008; Treynor, Gonzalez, & Nolen-Hoeksema., 2003). Reflection is associated with cognitive problem solving. An example is trying to solve a crossword puzzle. Here it is important to think deeply to come up with the words to solve it. However, rumination can become maladaptive when someone keeps brooding on the issue without coming to a solution. Brooding is seen as the passive comparison of the situation one is currently in with some unaccomplished situation (Nolen-Hoeksema et al., 2008; Treynor et al., 2003). An example is that days after you tried to solve that crossword puzzle you continue to think about how come you were not able to solve it, what might have caused that, what kind of consequences that has for you as a person. Rumination is associated with all types of psychopathology (Aldao & Nolen-Hoeksema, 2010) and brooding particularly with depressive symptoms (Treynor et al., 2003).

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Emotion regulation and eating behaviour

The different consequences adaptive and maladaptive emotion regulation strategies have on physiology and behaviour are extended to eating behaviour as well. For example, using an adaptive emotion regulation strategy, such as reappraisal, will prevent you from starting to eat (Taut, Renner, & Baban, 2012). In a study done by Taut and colleagues (2012) participants were free to eat from two bowls of food, containing a salty and sweet snack, during the entire experiment. The experimenter stayed in the room during induction of negative emotions and emotion regulation. Findings revealed that, after the experimenter had left the room, only 33% of participants in the reappraisal condition started eating compared to 66% of the suppression and control condition. However, once someone started eating the amount and type of food intake was the same across the emotion regulation conditions. In addition, reappraising high- and low-caloric food items can influence cravings for those food items (Reader, Lopez, & Denny, 2018). In their study, Reader and colleagues, instructed participants to regulate their cravings for high- and low-caloric food items by focusing on their long-term health consequences if one would eat that food item repeatedly. Results revealed that participants who had greater success on the regulation task had less cravings for high caloric foods and more cravings for low caloric foods compared to less successful participants. Taken together these findings illustrate that using an adaptive emotion regulation strategy, such as reappraisal, can be beneficial for your health as it will prevent you from eating when confronted with food and it can positively change cravings for healthy and unhealthy food items.

However, using a maladaptive emotion regulation strategy such as suppression, has differential consequences. For example, suppression increases the chances someone will start eating (Taut et al., 2012), increases the amount of food intake (Evers et al., 2010; Lu, Tao, Hou, Zhang, & Ren, 2016), affects the type of food that people eat (Evers et al., 2010) and

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can affect food choice in a dining partner of someone who is suppressing emotions (Ferrer, Green, Oh, Hennesy, & Dwyer, 2017). Ferrer and colleagues found that if an adolescent is suppressing emotions, parents are more likely to eat less fruits and vegetables and more caloric rich foods. Moreover, in a study done by Evers and colleagues (2010) participants took part in a bogus taste test. After negative emotions were induced, participants were instructed to taste the food. However, no instructions were given on amount of food. Their findings revealed that participants who naturally made more use of suppression increased their food intake more compared to low use of suppression, but only if they were emotional. In addition, participants who were instructed to suppress their emotional expression ate more comfort food compared to those who were instructed to reappraise them or got no emotion regulation instruction. All in all, these findings show that suppressing emotions increases the likelihood to start eating, and once someone starts to eat, it also results in increased food intake compared to reappraising emotions. Moreover, these results indicate that not the emotional experience per se results in a change in eating behaviour, rather it is about the way these emotions are regulated.

These findings compellingly illustrate that emotion regulation has an impact on eating behaviour, with reappraisal triggering healthy eating behaviour and suppression triggering unhealthy eating behaviour. However, there is hardly any evidence on other prevalent emotion regulation strategies such as rumination. Even though, rumination predicts the onset of binge eating in healthy female adolescents (Nolen-Hoeksema, Stice, Wade, & Bohon, 2007) and increased engagement in binge eating behaviour in healthy females (Selby, Anestis, & Joiner, 2007). It is, therefore, surprising that this emotion regulation strategy has not been researched extensively yet in relation to eating behaviour.

Currently, there is only one study looking into the relationship between rumination on negative affect and eating behaviour (Kubiak, Vögele, Siering, Schiel, & Weber, 2008). In

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this momentary assessment study obese female adolescent women were followed for seven days on their daily hassles, momentary negative mood, their relative rumination in relation to these daily hassles, and their desire to eat. Findings revealed that rumination on negative affect was a significant predictor for desire to eat, whereas daily hassles were not. Thus, this study replicates the idea that emotion regulation plays a central role in the relationship between negative affect and eating behaviour. Moreover, it also shows that rumination, as a maladaptive emotion regulation strategy, deserves further empirical attention. As the relationship between rumination and eating behaviour has not been assessed directly in an experimental design, the present study fills this vacuum.

The main research question of the present study is: *Does a maladaptive emotion regulation strategy like rumination lead to an increased desire to eat compared to a relatively adaptive emotion regulation strategy like reappraisal?* It was hypothesized that after emotion regulation instructions, desire to eat will be higher in the rumination condition compared to the reappraisal condition. This question will be tested in an experimental design, with an autobiographical memory task to elicit sadness after which emotion regulation style will be manipulated by randomly assigning participants to a reappraisal or rumination condition. Sadness was chosen as the target emotion, as previous work has illustrated that sadness leads to a stronger tendency to eat (Meule, Reichenberger, & Blechert, 2018). In addition, as previous work repeatedly emphasized that it is not the emotion per se that elicits a change in eating behaviour, it is hypothesized that the experience of sadness per se does not lead to an increased desire to eat. As difficulties with emotion regulation and emotional eating are seen as gateways to eating disorder behaviour (Leehr, Krohmer, Shag, Dresler, Zipfel, & Giel, 2015; Smith, Mason, & Lavender, 2018; Stice, 1994; Stice, 2001; Stice, Presnell, & Spangler, 2002), measures of eating disorder symptomatology, eating in response to emotions, emotion regulation strategies and restraint eating are included in this study. These factors will be used

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for exploratory analyses to further investigate their impact on the relation between negative emotions and desire to eat.

Method

Participants

A total of 98 participants participated in this online experimental study. Data from incomplete participation ($n = 27$) and invalid answers after instructions¹ ($n = 6$) were excluded from analyses. Sample characteristics are displayed in Table 1. The final sample consisted of 65 participants of which 83.1% female, aged 23-83 years old ($M = 43.15$, $SD = 16.89$). In total, 92.4% was higher educated and the mean BMI was 22.9 ($SD = 3.35$). The measure of eating disorder symptomatology revealed that 20% ($n = 13$) scored full threshold anorexia nervosa, 4.6% ($n = 3$) scored full threshold bulimia nervosa, 1.5% ($n = 1$) scored sub threshold anorexia nervosa and 4.6% ($n = 3$) scored sub threshold bulimia nervosa. There were 33 participants in the reappraisal condition and 32 participants in the rumination condition. Participants were recruited via Utrecht University, the social media platform Facebook, and via personal network. As compensation participants were provided with course credit or a chance to win a gift certificate of €20.

Procedure

This study was based on the procedure used in Ray, Wilhelm and Gross (2008). Participants received a personal link via email. They could log into this link on their own computer. A screen appeared with an explanation what this study was about. The true purpose of the study was masked with a cover up story telling participants that the study examined the relationship between autobiographical memories and lifestyle. After signing the informed consent form, demographic information was assessed. In addition, currently experienced

¹ Meaning, participants did not want to share their sadness evoking event or upon further inspection did not experience a sadness evoking event.

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hunger was measured to control for its effect on desire to eat. Furthermore, baseline measures (T0: “pre-recall”) of emotions they were experiencing, and desire to eat were taken. Next, all participants were asked to call to mind a recent event in the past two weeks that gave them a feeling of sadness. Participants were instructed to write about this event as if they were talking to a friend and for as long as they needed to re-experience feelings of being sad. The duration of this phase was at least 90 seconds and after this phase emotions and desire to eat were measured (T1: “post-recall”). Dependent on the condition, participants were randomly assigned to either the rumination or reappraisal condition. In the *rumination* condition, participants were instructed to write about the causes and consequences of the sadness-evoking event from their own perspective. In the *reappraisal* condition, participants were instructed to do so from a third person perspective, such as from an objective mediator whose goal it is to get the best outcome for all parties involved. The duration of this phase was again at least 90 seconds. After this phase emotions and desire to eat were measured (T2: “post-emotion regulation”), followed by a manipulation check to measure the extent to which a participant regulated their emotions by using rumination or suppression. Next all participants were asked to fill out questionnaires measuring several explorative variables. Finally, participants were debriefed and provided with course credit or a chance to win a gift certificate of €20.

Measures

Manipulation checks.

Emotions. Emotions were assessed by asking participants about three sadness-related emotions (sadness, depressed, and worried) that were combined into a sadness scale (T0: $\alpha = .80$, T1: $\alpha = .79$, T2: $\alpha = .89$) and three positive emotions (happiness, contentment, and cheerfulness) that were combined into a happiness scale (T0: $\alpha = .82$, T1: $\alpha = .92$, T2: $\alpha = .96$)

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(Evers et al., 2010). Answers were scored on 7-point Likert type scales ranging from 1 (not at all) to 7 (very much). The higher the score the more someone experienced that emotion.

Emotion regulation. Emotion regulation was on the one hand checked by two items retrieved from the rumination scale of Stressverarbeitungsfragebogen für Kinder und Jugendliche, SVF-KJ (coping with stress for children and adolescents: Hampel, Pietermann & Dickow, 2000 cited by Kubiak et al., 2008). Namely, “It is hard to think about something else” and “My thoughts still resolve about the issue”. These items were rated on 5-point Likert scales ranging from 0 (not at all) to 4 (a lot). A higher score indicated that person was still ruminating over the problem. On the other hand, it was checked by two additional separate items relating to the manipulation in a more direct way. Participants had to indicate the extent to which they thought about the event from their own and third-person perspective (Ray et al., 2008). These items were rated on VAS scales ranging from 0 (not at all) to 100 (a lot). A higher score indicated whether someone was ruminating (own perspective) or reappraising (third person perspective) the situation.

Eating behaviour.

Desire to eat. Desire to eat was measured using the desire to eat factor of the State Food Cravings Questionnaire, FCQ-S (Cepeda-Benito, Gleaves, Williams, & Frath, 2000, with subscale desire to eat ($T_0: \alpha = .76$, $T_1: \alpha = .91$, $T_2: \alpha = .93$). This factor contained 3 items: “I have an intense desire to eat [one or more specific foods]”, “I’m craving [one or more specific foods]”, and “I have an urge for [one or more specific foods]”. These were rated on 5-point Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree). A total of 3 filler items concerning well-being were added to mask the true purpose of the study. A high score indicated that someone had a strong desire to eat.

Hunger. As a control variable hunger was measured at baseline using the craving factor of the above mentioned FCQ-S (Cepeda-Benito et al., 2000, subscale hunger $\alpha = .79$).

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This questionnaire measured the factor craving as a physiological state (i.e., hunger) and contained 3 items: “I am hungry”, “If I ate right now my stomach wouldn’t feel as empty”, and “I feel weak because of not eating”. Participants were asked to what extent they agreed, at this very moment, with the statement on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The higher the score the hungrier someone was.

Demographics and Explorative Measures.

Demographics. The following demographics were measured: social economic status, ethnicity, gender, age, and educational level.

Emotion regulation style. Emotion regulation style was measured using the emotion regulation questionnaire, ERQ (Gross & John, 2003). This 10-item questionnaire consists of two subscales: suppression (4 items, $\alpha = .68$) vs. reappraisal (6 items, $\alpha = .77$). Example items are “I keep my emotions to myself” vs. “I control my emotions by changing the way I think about the situation I’m in”. These items were rated on 7-point Likert scales ranging from 1 (strongly disagree) to 7 (strongly agree). The higher the score the more someone used that specific emotion regulation style.

Trait rumination was measured using the ruminative response scale, RRS (Roelofs, Muris, Huibers, Peeters, & Arntz, 2006, $\alpha = .93$). This questionnaire consists of 26 items such as “I think about how alone I feel” and “I think about how sad I feel” and includes two subscales: brooding (5 items, $\alpha = .65$) and reflection (5 items, $\alpha = .72$). The items were rated on 4-point Likert scales ranging from 1 (almost never) to 4 (almost always). A high score indicated that someone had a ruminative emotion regulation style. Moreover, a higher score on a subscale indicated more use of that specific style of rumination.

Eating style. Emotional eating style was measured using the Salzburg emotional eating scale, SEES (Meule et al., 2018, $\alpha = .80$, subscales happiness $\alpha = .93$, sadness $\alpha = .80$, anger $\alpha = .89$, anxiety $\alpha = .65$). This questionnaire had 20 items such as “When I am

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optimistic I” and “When I am anxious I ... “. These items were rated on a 5-point Likert scale ranging from 1 (I eat much less than usual) to 5 (I eat much more than usual). A higher score indicates whether someone has a tendency to eat more in response to emotions.

Restrained eating. Restrained eating was measured using the restraint scale, RS (Polivy, Herman, & Warsh, 1978, $\alpha = .80$). This scale contains 10 items such as “I diet” and “How conscious are you of what you eat?”. These items were rated on a 4 or 5-point Likert scale. Answers ranged from 0 (not at all) to 3 (strongly), from 0 (not at all) to 3 (extremely), from 0 (never) to either 3 or 4 (always), from 0 (0-0.5 kilo) to 4 (2.5 kilo or more), and from 0 (0 - 2.5 kilo) to 4 (10 kilo or more). A higher is suggestive of a more restraint eating style.

Eating disorder. Eating disorder was measured using the eating disorder diagnostic scale, EDDS (Krabbengborg et al., 2012, Stice, Telch, & Rizvi, 2000, $\alpha = .66$). This scale contains 22 items such as “Over the past three months has your weight influenced how you think about (judge) yourself as a person” and “During the past 6 months have there been times when you felt you have eaten what other people would regard as an unusually amount of food (e.g. a quart of ice cream) given the circumstances?”. Items were scored on Likert type scales, yes or no answers, frequency, and fill in response format. A high score is suggestive of the presence of eating disorder symptomatology.

Data analysis

To investigate the idea that not emotions per se but emotion regulation is responsible for increased desire to eat, difference scores were calculated for affect. Affect score differences were calculated as followed, between pre-recall (T0) and post-recall (T1), and between post-recall (T1) and post-emotion regulation (T2). In addition, these difference scores, plus negative affect at pre-recall (T0), and emotion regulation styles: reappraisal, suppression and brooding were mean centered to minimize collinearity (Aiken & West, 1991). To test this idea hierarchical regression analyses were performed for desire to eat at

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three different time points (T0, T1, T2). Furthermore, a repeated measures ANOVA will be performed with condition as independent variable and desire to eat as within-subjects variable at three different time points (T0, T1, T2).

Results

To provide an overview of all variables including their relations, Table 1 shows correlations between all measures. Age, hunger, and eating disorder symptomatology positively correlated with desire to eat at all time points, p 's < .05. Furthermore, the EDSS subscale feature was positively associated with desire to eat pre-recall (T0), $p = 0.05$. The following variables were positively associated with desire to eat post-recall (T1): negative affect pre-recall (T0), the rumination factor brooding, the EDSS subscales feature, binge eating disorder (BED) binge, bulimia nervosa (B.N.) binge, compensation and weight/shape concerns, p 's < .05. Desire to eat post-emotion regulation (T2) was positively associated with negative affect pre- (T0) and post-recall (T1), the rumination factor brooding and the EDSS subscales BED binge, B.N. binge and weight/shape concerns, p 's < .05.

Randomization Check

Randomization checks were performed using different tests. A chi square test was used for the categorical variables, gender, education, job status, profession, nationality and income by condition. An independent samples t-test was performed with the continuous independent variable age and with condition as grouping variable. Lastly, a MANOVA was performed with the explorative continuous variables, reappraisal, suppression, trait rumination, reflection, brooding, emotional eating styles (happiness, sadness, anger, anxiety), restrained eating, eating disorder symptomatology and BMI and with condition as fixed factor. No statistical differences were found on all demographical and explorative variables between conditions, p 's = .08 - .995.

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Table 1. Correlations between variables under study

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	M (SD)	
Age (1)	-																													43.15 (17.68)	
Gender (1= male, 2 = female) (2)	-.230	-																												1.83 (.38)	
BMI (3)	.338**	-.257*	-																											22.9 (3.35)	
Hunger (4)	-.210	.263*	-.065	-																										7.6 (2.62)	
DTE																															
T0 (5)	-.363**	.217	-.091	.410**	-																									8.66 (2.53)	
T1 (6)	-.427**	.141	-.108	.358**	.775**	-																								7.77 (3.07)	
T2 (7)	-.391**	.124	-.170	.361**	.748**	.912**	-																							7.54 (3.31)	
NA																															
T0 (8)	-.271*	.125	-.128	.035	.242	.245*	.292*	-																							5.88 (2.87)
T1 (9)	-.233	.055	.116	.241	.196	.221	.258*	.451**	-																						9.77 (4.09)
T2 (10)	-.243	-.016	.023	.188	.118	.133	.148	.252*	.747**	-																					8.94 (4.24)
Reappraisal (11)	.131	.011	-.105	.050	-.007	-.101	-.009	-.108	-.047	.037	-																				25.58 (5.17)
Suppression (12)	-.026	-.043	.018	-.048	.125	.147	.148	.335**	.298*	.221	.376**	-																			14.75 (4.52)
Trait Rumination (13)	-.382**	.161	-.233	.225	.137	.199	.208	.525**	.368**	.262*	-.034	.235	-																		43.85 (11.39)
Brooding (14)	-.275*	.211	-.205	.265*	.117	.246*	.250*	.469**	.305*	.267*	-.115	.274*	.850**	-																	1.79 (.45)
Reflection (15)	-.225	.262*	-.183	.257*	.105	.118	.146	.379**	.391**	.287*	.053	.164	.825**	.682**	-																1.74 (.52)
SEES																															
Happiness (16)	-.207	-.132	.090	-.081	.033	.109	.106	-.091	.079	.010	-.154	-.068	-.205	-.230	-.166	-															3.04 (.66)
Sadness (17)	.071	.061	-.120	-.063	.090	.193	.181	.110	.089	.028	.067	.120	.192	.269*	.175	-.528**	-														3.23 (.66)
Anger (18)	.145	.099	-.126	-.043	-.066	-.011	.088	.114	.053	.019	.025	.125	.056	.156	.000	-.393**	.648**	-													2.94 (.63)
Anxiety (19)	.062	-.082	.046	-.220	-.049	.004	.040	.078	-.021	.018	.170	.118	.052	.085	-.042	-.392**	.671**	.614**	-												2.81 (.46)
Restraint eating (20)	-.046	.123	.421**	.181	.170	.204	.150	.270*	.222	.190	-.071	.100	.259*	.292*	.169	-.307*	.309*	.169	.341**	-											1.18 (.54)
EDDS																															
Total score (21)	-.214	.222	.358**	.183	.278*	.396**	.323**	.265*	.285*	.245*	-.072	.134	.290*	.314*	.210	-.173	.265*	.102	.235	.808**	-										14.83 (12.68)
Feature (22)	-.259*	.188	.168	.013	.266*	.320**	.235	.302*	.235	.191	-.017	.182	.381**	.333**	.291*	-.289*	.359**	.143	.334**	.716**	.813**	-									1.06 (1.69)
BED binge (23)	-.150	.144	.087	.234	.085	.319*	.306*	.189	.200	.304*	.059	.214	.455**	.539**	.399**	-.489**	.355*	.284	.407**	.678**	.744**	.905**	-								.13 (.45)
B.N. binge (24)	-.138	.178	.256	.057	.262	.353**	.319*	.110	.176	.174	.036	.110	.317*	.327*	.324*	-.255	.290*	.095	.319*	.669**	.812**	.883**	.962**	-							.36 (.7)
Compensation (25)	-.150	.189	.116	-.093	.073	.246*	.203	.184	.087	.141	.040	.155	.145	.108	.060	-.323**	.341**	.264*	.422**	.560**	.612**	.589**	.719**	.568**	-						.95 (2.39)
Total score (26)	-.227	.164	.206	.015	.034	.169	.108	.125	.048	.023	-.022	-.008	.172	.066	.043	-.258*	.303*	.182	.311*	.575**	.608**	.509**	.558**	.416**	.818**	-					.4 (.75)
Weight/Shape concerns (27)	-.204	.252*	.139	.352**	.236	.328**	.327**	.339**	.271*	.191	-.056	.156	.357**	.421**	.259*	-.085	.174	.124	.145	.531**	.765**	.481**	.343*	.439**	.315*	.295*	-			1.25 (.77)	
Fear of weight (28)	-.052	.200	.290*	.075	.176	.225	.168	.175	.125	.205	-.045	.053	.103	.190	.050	-.106	.263*	.142	.119	.635**	.772**	.602**	.443**	.618**	.380**	.447**	.554**	-		1.08 (.8)	
Amenorrhea (29)	-.241	. ^c	.060	.131	.138	.231	.161	-.029	.077	.094	-.046	.245	-.031	.094	.030	.227	-.013	-.073	-.131	.044	.227	.117	.121	.128	-.014	-.072	.187	.278*	-	.5 (.86)	

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

^cDichotomous variable. All other variables are (treated as) continuous variables. Bivariate Pearson correlations were calculated between continuous and dichotomous variables.

BED = Binge eating disorder. B.N. = Bulimia Nervosa

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Manipulation Checks

Emotion experience. Negative emotion experience was tested using a repeated measure ANOVA with condition as independent variable and sadness-related emotions as within-subjects variable at three different time points (T0, T1, T2), see Figure 1. Negative emotions at pre-recall (T0), and post emotion regulation (T2) were non-normally distributed (skewness $NA_{T0} = 1.78$, $SE_{NA_{T0}} = .30$, kurtosis $_{NA_{T0}} = 5$, $SE_{NA_{T0}} = .59$; skewness $NA_{T2} = .68$, $SE_{NA_{T2}} = .30$, kurtosis $_{NA_{T2}} = .18$ $SE_{NA_{T2}} = .59$). The assumption for normality was only met at pre-recall (T1). Mauchly's test indicated that the assumption of sphericity was violated, $\chi^2(2) = 14.82$, $p = .001$, Greenhouse-Geisser tests are reported ($\epsilon = .83$). Tests of between-subjects effects showed that condition did not significantly differ for the amount of negative emotions experienced $F < 1$. Time significantly affected negative emotions, $F(16.5, 103.91) = 39.72$, $p < .001$, $\eta_p^2 = .39$. Pairwise comparisons showed that after recalling a sadness evoking event, negative emotions increase ($M_{T0} = 5.87$, $SD_{T0} = 2.87$; $M_{T1} = 9.77$, $SD_{T1} = 4.09$), $p < .001$. However, negative emotions decrease after emotion regulation ($M_{T1} = 9.77$, $SD_{T1} = 4.09$; to $M_{T2} = 8.94$, $SD_{T2} = 4.24$), $p = .02$. There was a significant interaction effect, $F(16.5, 103.91) = 3.83$, $p = .03$, $\eta_p^2 = .06$, indicating that the experience of negative emotions differed

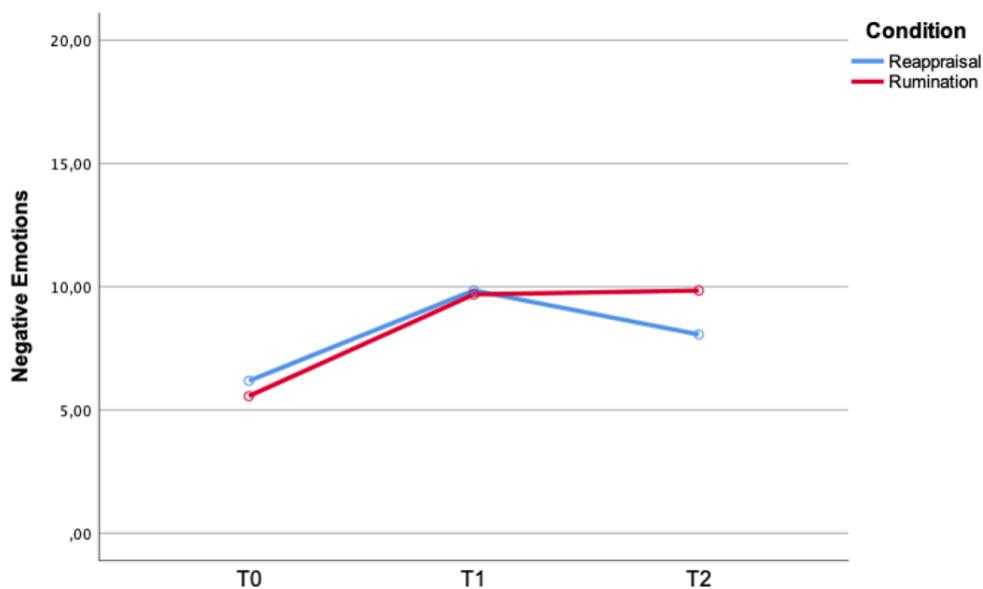


Figure 1. Mean experience of negative emotions at pre-recall (T0), post-recall (T1) and post-emotion regulation (T2) per condition.

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per condition dependent on time. Simple main effects revealed that negative emotions significantly increased from pre- (T0) to post-recall (T1) in both conditions ($p < 0.001$). From post-recall (T1) to post-emotion regulation (T2) negative emotions decreased significantly in the reappraisal condition ($M_{\text{Reappraisal_T1}} = 9.85$, $SD_{\text{Reappraisal_T1}} = 4.18$, $M_{\text{Reappraisal_T2}} = 8.06$, $SD_{\text{Reappraisal_T2}} = 3.86$), $p = .001$, while they did not change in the rumination condition ($M_{\text{Rumination_T1}} = 9.69$, $SD_{\text{Rumination_T1}} = 4.06$, $M_{\text{Rumination_T2}} = 9.84$, $SD_{\text{Rumination_T2}} = 4.49$), $p = .76$.

Positive emotion experience was tested using a repeated measure ANOVA with condition as independent variable and happiness-related emotions as within-subjects variable at three different time points (T0, T1, T2), see Figure 2. The assumption of normality was met. Mauchly's test indicated that the assumption of sphericity was violated, $\chi^2(2) = 21.89$, $p < .001$, Greenhouse-Geisser corrected tests are reported ($\epsilon = .77$). Tests of between-subjects effects showed that the conditions did not significantly differ from each other on the amount of positive emotions experienced, $F < 1$. Time significantly affected positive emotions, $F(1.54, 97.11) = 41.19$, $p < .001$, $\eta_p^2 = .40$. Pairwise comparisons revealed that

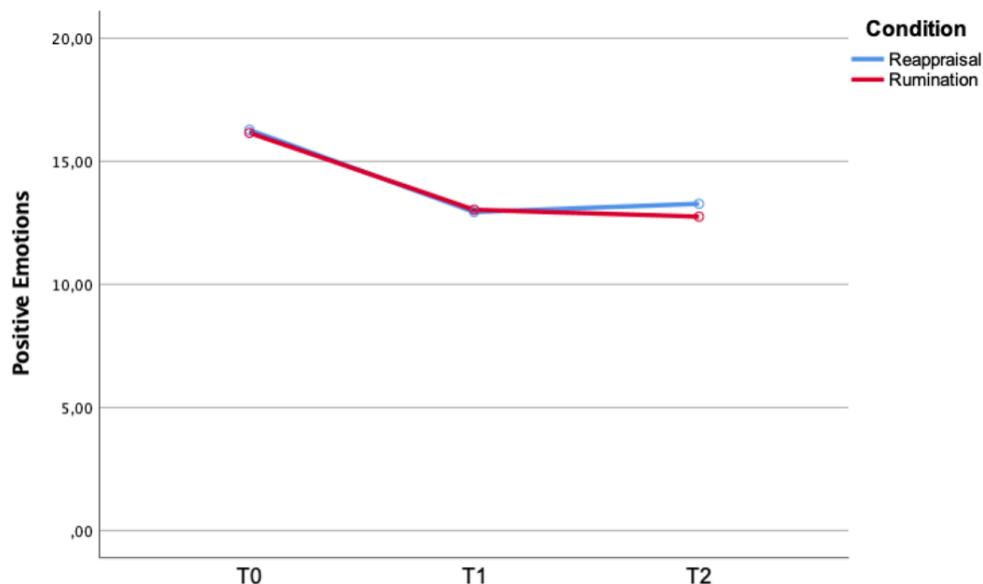


Figure 2. Mean experience of positive emotions at pre-recall (T0), post-recall (T1) and post-emotion regulation (T2) per condition.

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positive emotions significantly decreased from pre- (T0) to post-recall (T1) ($M_{T0} = 16.22$, $SD_{T0} = 2.73$, $M_{T1} = 12.99$, $SD_{T1} = 4.20$), $p < .001$, and stayed the same from post-recall (T1) to post-emotion regulation (T2) ($M_{T1} = 12.99$, $SD_{T1} = 4.20$; to $M_{T2} = 13.02$, $SD_{T2} = 4.62$), $p = .93$. The non-significant interaction effect, $F < 1$, indicates that conditions did not differ on positive emotions at any of the time points.

It can be concluded that recalling a sadness evoking memory was thus successful at inducing negative emotions and decreasing positive emotions. Moreover, reappraising the situation led to a decrease in negative emotions whereas ruminating over the situation did not.

Emotion regulation. The Emotion regulation manipulation was checked by using two separate MANOVA's with condition as independent variable and the items measuring emotion regulation as dependent variables. First, a MANOVA with the two items retrieved from the SVF-KJ was performed. The assumptions of equality of covariance matrix, $F < 1$ and homogeneity of variances were met, p 's $> .74$. No significant differences between conditions were found, p 's > 0.29 , indicating that according to this scale participants did not differ in the amount of thoughts that still revolved around the event and how hard it was to think about something else. Secondly, a MANOVA with the two items retrieved from Ray et al. (2008) was performed. The assumptions of equality of covariance matrix, $F(3) = 5.33$, $p = .001$, and homogeneity of variances was only violated for the question measuring whether someone thought about the incident from their own perspective, $p_{\text{own_perspective}} < .001$, $p_{\text{thirdperson_perspective}} = .23$. Tests of between-subjects effects revealed a significant condition effect, $F(1,63) = 4.42$, $p = .04$, $\eta_p^2 = .07$. As expected, participants in the rumination condition thought significantly more about the event from their own perspective ($M_{\text{Rumination}} = 77.06$, $SD_{\text{Rumination}} = 17.58$.) than participants in the reappraisal condition ($M_{\text{Reappraisal}} = 63.88$, $SD_{\text{Reappraisal}} = 30.96$). No statistical difference was found between conditions on whether

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participants thought more about the event from a third persons' perspective ($M_{\text{Reappraisal}} = 42.49$, $SD_{\text{Reappraisal}} = 32.71$, $M_{\text{Rumination}} = 33.88$, $SD_{\text{Rumination}} = 27.91$, $F = 1.3$), $p = .26$.

As at least one of the more direct indicators was significant we carefully speculated that the manipulation of rumination was successful, also because negative emotions showed a pattern consistent with the expected effects of rumination and reappraisal. However, whether the manipulation of reappraisal was successful remains unclear based on these results.

Eating Behaviour

Desire to eat. As the correlation table showed that hunger, age and eating disorder symptomatology significantly correlated with desire to eat at pre recall (T0), these variables were included as covariates. Even though, the EDDS subscale feature, which measures aspects of binge like behaviour, was associated with desire to eat at pre-recall (T0) as well. It was not included as a covariate as it is also part of the total score on the EDDS². A repeated measures ANCOVA was performed with condition as independent variable, desire to eat as within-subjects variable at three different time points (T0, T1, T2) and with hunger, age and eating disorder symptomatology as covariates, see Figure 3. The assumptions of normality and linear relationship between the covariates and dependent variable were met. However, as Mauchly's test indicated that the assumption of sphericity was violated, $\chi^2(2) = 16.61$, $p < .001$, Greenhouse-Geisser corrected tests are reported ($\epsilon = .80$). The non-significant condition effect indicates that emotion regulation condition did not affect desire to eat, $F < 1$. Although the results show that time in general did not significantly affect desire to eat, $F < 1$, we looked at planned contrasts given our specific hypotheses (Rosnow & Rosenthal, 1995). Simple main effects revealed that desire to eat significantly decreased from pre- (T0) to post-recall (T1) ($M_{T0} = 8.66$, $SD_{T0} = 2.53$, $M_{T1} = 7.77$, $SD_{T1} = 3.07$), $p = .001$, while staying the

² The main findings were not affected by adding feature as a covariate to a repeated measure ANCOVA with condition as independent variable, desire to eat as within-subjects variable at three different time points (T0, T1, T2) and with hunger and age or with hunger, age and EDDS as covariates.

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same from post-recall (T1) to post-emotion regulation (T2) ($M_{T1} = 7.77$, $SD_{T1} = 3.07$, $M_{T2} = 7.54$, $SD_{T2} = 3.31$), $p = .55$. The non-significant interaction effect, $F < 1$, indicates that conditions did not differ in desire to eat at any of the time points (reappraisal condition: $M_{T0} = 8.73$, $SD_{T0} = 2.21$, $M_{T1} = 7.88$, $SD_{T1} = 2.75$, $M_{T2} = 7.70$, $SD_{T2} = 2.80$, rumination condition: $M_{T0} = 8.59$, $SD_{T0} = 2.85$, $M_{T1} = 7.66$, $SD_{T1} = 3.41$, $M_{T2} = 7.38$, $SD_{T2} = 3.80$). These results show that, contrary to the hypotheses, desire to eat decreased after experiencing negative emotions, but was not affected by condition.

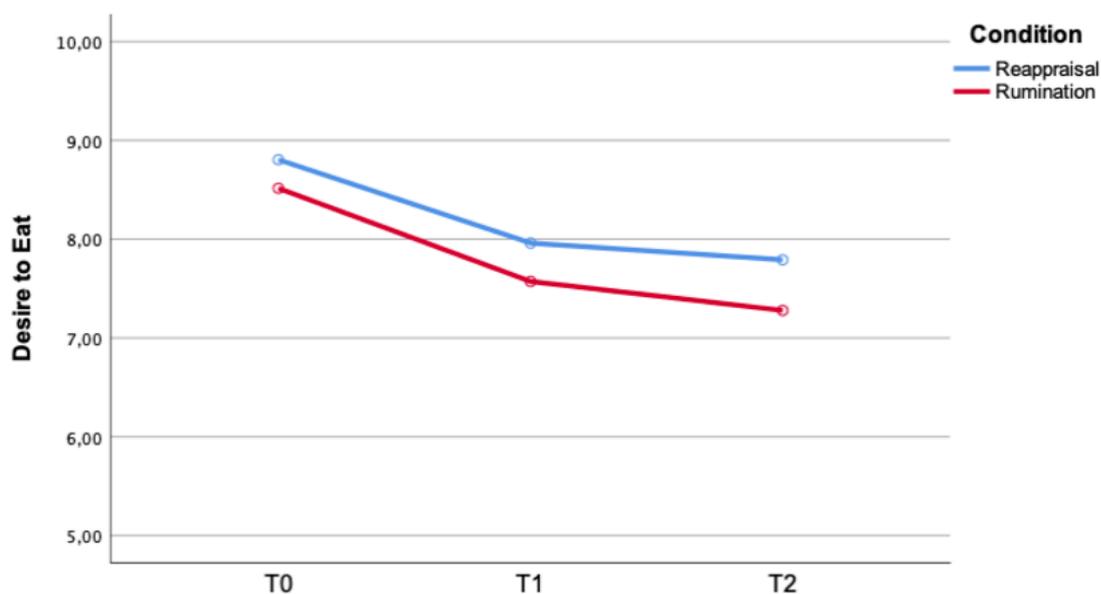


Figure 3. Mean desire to eat at pre-recall (T0), post-recall (T1) and post-emotion regulation (T2) per condition.

Negative emotions and desire to eat. Hierarchical regression analyses were performed to test our hypothesis that emotions per se do not predict desire to eat. Three hierarchical regression analyses were performed for each time point desire to eat was measured. First, desire to eat pre-recall (T0) was regressed onto the control variable hunger (Step 1) and negative affect pre-recall (T0) (Step 2). The assumptions of normality of residuals and homoscedasticity were violated. Furthermore, analysis of mahalanobis distance

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(with $MD < 13.81$, for regression analysis with two predictors) was carried out on the data to detect outliers. Results indicated the presence of an outlier that was removed before analysis. The remaining assumptions were met. Second, desire to eat post-recall (T1) was regressed onto the control variable hunger (Step 1) and difference in negative affect from pre-recall (T0) to post-recall (T1) (Step 2). The assumptions of normality of residuals and homoscedasticity were violated. The remaining assumptions were met. Third, desire to eat post-emotion regulation (T2) was regressed onto the control variable hunger (Step 1) and difference in negative affect from post-recall (T1) to post-emotion regulation (T2) (Step 2). Furthermore, analysis of mahalanobis distance (with $MD < 13.81$, for regression analysis with two predictors) was carried out on the data to detect outliers. Results indicated the presence of an outlier that was removed before analysis. The remaining assumptions were met.

The results revealed that at step 1, hunger always predicted desire to eat throughout the experiment, see Table 2 for results. This indicates that desire to eat is higher for people that have more hunger. At step 2, when desire to eat pre-recall (T0) was predicted hunger ($\beta = .42$, $p = .001$) and negative affect ($\beta = .23$, $p = .05$) were significant predictors. When desire to eat post-recall (T1) was predicted hunger ($\beta = .36$, $p = .003$) was a significant predictor whereas, as expected, negative affect difference between pre-recall (T0) and post-recall (T1) ($\beta = -.03$, $p = .79$) was not. Finally, when desire to eat post-emotion regulation (T2) was predicted, again, hunger ($\beta = .35$, $p = .004$) was a significant predictor whereas, as expected, negative affect difference between post-recall (T1) and post-emotion regulation (T2) ($\beta = -.12$, $p = .31$) was not.

Explorative Measures

As exploration, variables that correlated with desire to eat at at least one time point were separately added as covariates (the trait rumination factor brooding, and the following subscales of the EDDS: feature, BED binge, B.N. binge, compensation, weight/shape

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Table 2.

Regression results of hierarchical regressions examining desire to eat (DTE) at all time points as dependent variables: pre-recall (T0), post-recall (T1) and post-emotion regulation (T2).

	<i>F</i> Change	β	R ²
DTE pre-recall (T0)			
Step 1	$F(1, 62) = 12.90^*$.17*
Hunger		.42*	
Step 2	$F(1, 61) = 4.04^{***}$.22***
Hunger		.39*	
NA T0		.23***	
DTE post-recall (T1)			
Step 1	$F(1, 63) = 9.26^{**}$.13**
Hunger		.36**	
Step 2	$F < 1$.13
Hunger		.36**	
Difference in NA T0-T1		-.03	
DTE post-emotion regulation (T2)			
Step 1	$F(1, 62) = 8.99^{**}$.13**
Hunger		.36**	
Step 2	$F(1, 61) = .12$.13
Hunger		.36**	
Difference in NA T1-T2		-.04	

* $p = .001$

** $p < .004$

*** $p = .05$

concerns, see Table 1) to a repeated measures ANCOVA with condition as independent variable, desire to eat as within-subjects variable at three different time points (T0, T1, T2) and with hunger as covariate.

Contrary to our expectations, the results did actually not reveal any additional effect of the covariates on the manipulation of emotion regulation. There was, however, an overarching effect of the covariates on the baseline measures. As the results revealed two interaction effects of time x BED binge and time x compensation on desire to eat from pre-recall (T0) to post-recall (T1). Unfortunately, it was not possible to further explore this interesting interaction due to the power of this study. Therefore, no suggestions about what these findings indicate are made.

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Emotion regulation style and desire to eat. Hierarchical regression analyses were performed with hunger and trait emotion regulation style, suppression, reappraisal, brooding as predictors and with desire to eat at pre-recall (T0), post-recall (T1) and post-emotion regulation (T2). Trait emotion regulation style did not predict desire to eat at any time point, p 's > .17.

Discussion

In the present study the relation between adaptive and maladaptive emotion regulation strategies and eating behaviour was investigated. Rather than to centre attention on negative emotions being the causing factor of increased desire to eat, it was expected that the type of emotion regulation strategy would be responsible for the desire to eat. Adopting an experimental design, a maladaptive emotion regulation strategy, rumination, was compared with an adaptive one, reappraisal. To generate negative affect and manipulate the emotion regulation strategies, a sadness-evoking autobiographical memory recall method was used. Results revealed, contrary to the hypothesis, that desire to eat was not affected by type of emotion regulation strategy used. Overall, regardless from emotion regulation strategy, the experience of sadness per se did not predict desire to eat. Moreover, after recalling a sadness evoking event desire to eat even decreased. This confirms the hypothesis that sadness per se does not lead to increased desire to eat.

To explain the unexpected finding that amount of desire to eat was not affected by emotion regulation strategy, it is important to further discuss details of the study and compare these with other studies. To start with our measure of eating behaviour, the present findings are in contrast with previous work that illustrated that different emotion regulation strategies shape differences in eating behaviour. For example, findings revealed that after suppression, a maladaptive emotion regulation strategy, participants were more likely to start eating and ate more comfort food in a bogus taste test compared to reappraisal or spontaneously expressing

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emotions (Evers et al., 2010; Taut et al., 2012). However, Taut and colleagues (2012) also demonstrated that once participants started eating, participants both in the reappraisal and suppression conditions ate the same amount of comfort food. There are some important differences between these studies and the current study that are worth mentioning. For example, these studies were conducted in the laboratory with actual eating measures. Thus, eating was assessed in a controlled, standardized environment with options to exclude biases that are omnipresent in daily life. The current study, however, was an online study with self-reported desire to eat. This is obviously different than assessing actual food intake in a laboratory setting. Moreover, the importance of measuring actual food intake was emphasized in a study done by Evers, de Ridder and Adriaanse (2009). Their findings revealed that self-reported emotional eaters do not actually increase their food intake after negative affect. Even though people believe they would eat more after the experience of negative emotions, their actual behaviour does not show this. This discrepancy between actual behaviour and beliefs about behaviour and the findings of this study, stresses the importance that future research should investigate actual food intake as a measure for eating behaviour.

To further investigate our unexpected findings, it is paramount to consider the manipulation of emotion regulation. The manipulation of emotion regulation seemed successful. To illustrate, participants in the rumination condition thought about the event more from their own perspective compared to participants in the reappraisal condition. Furthermore, negative emotions remained unaffected in the rumination condition whereas negative emotions decreased in the reappraisal condition. This is in line with Ray and colleagues' (2008) findings that after rumination, negative emotional ratings remained the same from pre- to post-regulation. Furthermore, when participants were repeatedly asked to either ruminate or reappraise those emotions. Results revealed that whereas reappraisal was able to reduce negative emotion experience with every session, ruminating on the negative

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emotion, emotional experience remained unchanged over time (Ray et al., 2008). These findings support the notion that rumination is not able to decrease levels of emotional experience (Treyner et al., 2003) and therefore a maladaptive emotion regulation strategy (Gross, 1999). Furthermore, as rumination is defined as a repetitive process (Aldao & Nolen-Hoeksema, 2010; Gross, 1999), and becomes only maladaptive when no solution is reached after reflecting on the event (Treyner et al., 2003). It could, therefore, be that it is about ruminations cumulative effect over time rather than a one-time manipulation. In the case of ecological studies, the cumulative effects of rumination occur naturally which could explain why these studies do find effects of rumination on eating behaviour (Kubiak et al., 2008). These findings hint at that it could be that time spent ruminating about the event was not sufficiently long enough to mimic rumination as experienced in real life. The above-mentioned results suggest that time spent ruminating about the event could play an important role in the relation between emotion regulation and eating behaviour and deserves further empirical attention.

Besides the design of the study more insight can be gained by looking at it from a biological perspective. A biological perspective can broaden our view on the finding that desire to eat *decreased* rather than *increased* after negative affect was induced. Whereas psychological theories only postulate that food intake increases after negative affect, biological studies have shown the opposite effect. Namely, findings from biological studies have revealed that negative emotions actually suppress appetite (Heinrichs & Richard, 1999; Richard et al., 2002). However, what remains unclear is why, for example, this is not the case in people that have binge eating disorder or obesity. As they still tend to overeat after experiencing negative emotions. A possible explanation could be that in the long term the hormones that cause the feeling of satiety, over time lead to brain sensitivity to satiety (Zakrzewska, Cusin, Sainsbury, Rohner-Jeanrenaud, & Jeanrenaud, 1997; Zakrzewska et al.,

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1999; Jequir, 2002). As more glucocorticoids are released into the bloodstream in the hours to days after a stressful event the effect of glucocorticoids is twofold. On the one hand, they stimulate the release of leptin, a hormone signalling the brain it is satiated. On the other hand, in the long-term glucocorticoids contribute to insensitivity for leptin in the brain (Zakrzewska et al., 1997, 1999; Jequir, 2002). This hints at a dysregulation of satiety signalling between the body and brain, partly caused by chronic stressors. This information is important as exposure to chronic stress, such as constant physiological arousal caused by rumination on negative emotions (Ray et al., 2012) can cause biological dysfunction in the long-term. Especially since rumination is found to cause greater sympathetic activation every time someone thinks again about the same negative event (Ray et al., 2012). This suggests that rumination constantly refreshes the physiological arousal mimicking a chronic stressor. Therefore, in future work attention should be paid to the interaction between physiology and psychology to deepen our understanding of how negative emotions can influence eating behaviour.

Implications

The findings presented here are a first step to fill the vacuum in the eating behaviour literature where emotion regulation styles such as reappraisal and suppression have a prominent place compared to another emotion regulation strategy, rumination. These results try to bridge the gap between different emotion regulation strategies on the one hand and eating behaviour on the other. As this is the first study, as far as we know, to use an experimental design to better understand the causal link between rumination and eating behaviour, implications should be interpreted with caution.

To start with that contrary to the definition of emotional eating (Van Strien et al., 1986), desire to eat *decreased* instead of *increased* after negative affect was induced. In addition, negative emotional experience was not able to predict desire to eat. As there is a growing body of evidence supporting the idea that it is not the emotion per se that causes an

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increase in eating behaviour (Evers et al., 2009; Evers et al., 2010; Kubiak et al., 2008; Taut et al., 2012), this study confirmed this idea once more. In light of these results it seems that the relationship between negative emotions and eating behaviour is more complicated than is currently captured by the definition of emotional eating. Moreover, research has shown that when negative emotions are investigated in relation to other factors such as daily hassles. It is the interaction, between negative emotions and daily hassles, that is able to predict desire to eat (Kubiak et al., 2008). This suggests that it is indeed not the emotion per se, but it might be about the interaction between negative emotions and other important factors. Furthermore, in relation to emotion regulation such an interaction between emotion regulation and other factors could also play an important role in predicting eating behaviour. For the reason that this study replicated the finding of Evers and colleagues (2010) that trait emotion regulation style alone is not able to predict eating behaviour. However, Evers et al.'s results did reveal that, again, the interaction between trait emotion regulation and experimental condition was able to predict food intake. The above-mentioned results illustrate a dynamic interplay between different factors related to emotional experience, emotion regulation and eating behaviour that warrants further empirical investigation.

Related to this, to the best of my knowledge, this was the first study that tried to expand the emotional eating phenomenon to a more diverse age sample. Studies to date consist mainly of (female) students aged around 20 years (Taut et al., 2012; Evers et al., 2010). However, his study included males as well and the mean age was 43 years old. That it is important to investigate the relation between emotion regulation and eating behaviour in older age samples was emphasized by studies showing that emotion regulation changes with age (Brummer, Stopa, & Bucks, 2013; Opitz, Rauch, Terry, Urry, 2012; Scheibe, Kuba, & Spieler, 2016). Findings of these studies revealed that older adults on the one hand have more difficulties with reappraising negative emotions, however, on the other hand, suppression

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does not lead to as much physiological distress as it does in younger adults. Furthermore, in this study age was negatively associated with desire to eat at all time points, this indicates that at a higher age less desire to eat was experienced. Taken together, it might be possible that as the effects of emotion regulation changes with age its consequential effect on eating behaviour changes as well. These findings suggest a relevant role of age in relation to emotion regulation and eating behaviour.

In addition, even though this study was conducted online an effect of emotion regulation on emotions was observed. This hints towards the robust effect emotion regulation strategies have on emotions.

Lastly, we have observed that certain aspects of eating disorders may play an important role. As most of the subscales of the EDDS correlated with desire to eat. However, due to issues with power we were not able to conduct proper exploration of the relationship between these subscales, emotion regulation and desire to eat. These results, however, do demonstrate the importance of these concepts in relation to eating behaviour. Future research should define clear and testable hypotheses about the relationship between eating disorder symptomatology and eating behaviour. Especially considering the central role emotion regulation plays in binge eating disorder (Dingemans, Danner, & Parks, 2017) and ruminations transdiagnostic role in psychopathology (Aldao & Nolen-Hoeksema, 2010). Despite these implications, there are several limitations that need to be acknowledged.

Limitations

Firstly, as also mentioned above this study was conducted online. This brings forward several limitations. Such as that it is not possible to control for external distractions. These distractions can distract people from our manipulation attempt in the experiment as well as interact with the desire to eat measure. Related to the online design of this study is the absence of an association between restrained eating, as measured by the restraint eating scale

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(Polivy, Heatherthorn, & Herman, 1988), and desire to eat. Previous studies compellingly illustrated that only in restrained eaters negative emotions could impact eating behaviour (Cardi et al., 2015; Evers et al., 2018). A possible explanation for this absence could be that this study was conducted online and self-reported desire to eat was measured. Whereas the aim of the restraint scale is to predict actual eating behaviour. Thus, it could be that the type of restraint eating measured did not correspond to the type of eating behaviour measured, in this study. This indicates that it is important to take into account what kind of restrained eating and eating behaviour is measured and which measurement best captures this type of behaviour. In addition, as aligned above, this study did not measure actual food intake.

Moreover, from a statistical perspective, the significant decrease in desire to eat after recalling a sadness evoking event was based on a high degree of freedom. Thus, the effect found could be due to a type I error, falsely rejecting the null hypothesis. In addition, the effect size for negative emotional experience were very small, $\eta_p^2 = .06$. This indicates that the effect the recall method had on negative emotions was very small. These small effect sizes could be due to the online design of this study.

Lastly, the design of this study did not include a no regulation control group. Therefore, it is not possible to make any assumptions about what happens with desire to eat when emotions are freely or spontaneously regulated. Despite the limitations of this study, the study brought forward new insights and suggestions for future research. Especially as this was the first study, to my knowledge, that experimentally investigated the relationship between a relatively new emotion regulation strategy, rumination, and eating behaviour.

Conclusion

There seems to be an important relation between emotion regulation and eating behaviour, whereas the focus of the literature to date is mainly on reappraisal and suppression. The palette of emotion regulation strategies is more diverse, however, and especially the

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widely used strategy rumination deserves more empirical attention, particularly as rumination seems to play a transdiagnostic role in all psychopathology.

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