Has food lost its attraction in anorexia nervosa?
Neimeijer, Renate

Important note: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document version
Publisher's PDF, also known as Version of record

Publication date:
2018

Link to publication in University of Groningen/UMCG research database

Citation for published version (APA):

Copyright
Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

Take-down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): http://www.rug.nl/research/portal. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.
Chapter 7
General discussion
SUCCESSFUL AND UNSUCCESSFUL DIETING

Many people engage in dieting, but most people who start a diet fail, and some dieters eventually gain even more than they initially lost (Elfhag & Rössner, 2010; Jeffery et al., 2000). These people, who are very motivated to control their weight by dieting, but who are often unsuccessful in these attempts, have been referred to as restrained eaters (Herman & Polivy, 1980). Anorexia nervosa (AN patients) on the other hand, belong to the small minority of people who are able to maintain their restrictive eating pattern on the longer term. AN is a highly impairing mental disorder that is characterized by underweight and a disturbed body image. The key question of this thesis was how AN patients, in contrast to most dieters, succeed in maintaining a restrictive eating pattern, while they actually are in a state of starvation.

By nature, food has a high reward value, even more so for people who have been deprived of food, yet AN patients manage to overcome their biological drive to eat. To improve the understanding of this striking phenomenon, two cognitive motivational mechanisms that potentially contribute to the (dys)regulation of eating were studied in AN patients and in restrained eaters. A better understanding of these processes might eventually lead to better treatment options, which can directly target these processes. In this chapter, I will summarize and integrate the finding of the five empirical studies of this thesis (see Table 1 for a global overview of the results). Limitations, implications, and directions for further research will be discussed.

Table 1. Overview of the results of the studies in the current thesis.

<table>
<thead>
<tr>
<th>Measured construct</th>
<th>RSVP</th>
<th>SRC</th>
<th>AST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured construct</td>
<td>Temporal attentional bias</td>
<td>Automatic approach tendencies (food is task-relevant)</td>
<td>Automatic approach tendencies (food is task-irrelevant)</td>
</tr>
<tr>
<td>Comparison group</td>
<td>Little attentional capture</td>
<td>Approach bias</td>
<td>No bias</td>
</tr>
<tr>
<td>Restrained eaters</td>
<td>High attentional capture (both when food was task-relevant and task-irrelevant)</td>
<td>Reduced approach bias</td>
<td>Positive mood: approach bias</td>
</tr>
<tr>
<td>Anorexia patients</td>
<td>High attentional capture when food was task irrelevant</td>
<td>No bias</td>
<td>Avoidance bias</td>
</tr>
</tbody>
</table>

Note. In restrained eaters, a single and a dual target was administered. In AN patients, a single target RSVP was administered. RSVP = rapid serial visual Presentation; SRC= stimulus response compatibility task; AST = affective Simon task, manikin version.

ATTENTIONAL BIAS FOR FOOD

The first cognitive motivational mechanism that was studied, is attentional bias. It has been proposed that there is a reciprocal relationship between selective attention for food cues (attentional bias) and craving. This is assumed to develop as a consequence of associative learning and once established it could be a long-lasting characteristic (Franken, 2003). Following this view, attentional bias would
lead to craving for food, whereas in turn, increased craving would strengthen the attentional bias for food. Accordingly, people may end up in a self-reinforcing cycle, which will logically undermine their attempts to restrict their food intake. For AN patients it might, however, be that after prolonged and repeated starvation food loses its motivational salience (e.g., Veenstra & de Jong, 2011), and thereby also its attention grabbing power. If so, this may help prevent AN patients to enter this attentional bias-craving cycle and thus help them in persisting their restrictive food intake.

Previous research provided no straightforward information about the role of attentional bias in disordered eating. Most of these earlier studies on attentional bias in restrained eating exclusively focused on spatial selective attention. Studies found attentional approach, avoidance and no differences, for both AN patients and restrained eaters (see for a review: Faunce, 2002; Werthmann et al., 2015).

Importantly, attention is not only distributed in space, but also in time. The privileged processing of food cues may be especially prominent in the temporal dimension: the consequences of continued attention for food-related information for the processing of other (concurrently or subsequently appearing) information. For example, it could be that food stimuli are processed relatively efficiently and require less attentional resources (lower threshold) to enter people's awareness. Or, once a food stimulus has captured attention, it may be preferentially processed and granted prioritized access to limited cognitive resources (cf. Koster et al., 2009).

Earlier studies on temporal attentional bias in other domains than eating disorders have already shown that salient pictures can capture and hold attention to such a degree that they interfere with the detection of other cues, even after the picture had disappeared (Most et al., 2005). Such privileged access may not only prevent new information from entering working memory, but may also provide the opportunity for more elaborate processing of the food stimulus. Elaboration competes with concurrent cognitive tasks through retrieval of target related information and its retention in working memory (Kavanagh et al., 2005). Consequently, this might lead to craving and eventually food intake, thereby hampering one's diet goal. In contrast, attentional avoidance might prevent that one enters the attentional bias-craving-cycle, thereby facilitating the diet goal.

In the current thesis, this temporal dimension of attentional bias for food was studied in both AN patients and restrained eaters to fill this gap in the literature. In both studies, a Rapid Serial Visual Presentation Task (RSVP) was used. In the RSVP, task stimuli are presented sequentially without interstimulus interval on a computer screen. In every stream of pictures, one or two targets appear, that have to be identified after each stream. The deficit in the identification of the second target (T2) has been called the attentional blink, referring to the apparent refractory period following the presentation of the preceding target (T1). Temporal attentional bias can be expressed in different ways within the context of a RSVP task. First, the magnitude of attentional blink can be reduced when T2 is a salient cue and therefore T2 will be identified despite the preceding T1. Secondly, the appearance of a salient T2 (e.g., food) may interfere with the correct identification of a preceding T1. Furthermore, attentional blink can be heightened when T1 is a salient cue and, therefore, the
attentional blink will last longer than the usual attentional blink. Lastly, an attentional blink can be elicited when a salient task-irrelevant distractor (e.g., food) is presented shortly before the actual target. The distractor can be ignored but may nevertheless induce an attentional blink.

**Temporal attentional bias and restrained eating**

The study described in Chapter 2 tested these expressions of temporal attentional biases for food in high versus low restrained eaters. The most critical finding was that specifically in restrained eaters, food distractors elicited an attentional blink. That is, for restrained eaters, neutral targets were less often correctly identified when these were preceded by a food-related as compared to a neutral distractor. This is in line with earlier studies showing that salient distractors can hamper task performance (Most, Scholl, Clifford, & Simons, 2005; Most et al., 2007). Also in the current study participants were, independent of restraint status, distracted by threat pictures, thereby replicating the earlier finding that also negatively valenced stimuli can elicit an attentional blink. The current results thus indicated that even when food cues were presented as task-irrelevant distractors, these food cues nevertheless received prioritized processing in high restrained eaters. In other words, specifically in restrained eaters, food items attracted attention even though these items were irrelevant for their current goal.

Moreover, it was found that also specifically for high restrained eaters, there was an interference effect of a food T2 on identifying the preceding neutral T1. This is in line with previous research, which showed that T2 can have a detrimental influence on the identification of a preceding T1 (Potter et al., 2002). If two targets are presented in close proximity of each other, food cues might win the competition for attention because they receive prioritized access to limited attentional resources and/or are processed more elaborately in high restrained eaters, thereby overriding the previously encoded T1.

Independent of restraint status, the attentional blink was enlarged with a food T1 as compared to a neutral T1. Supporting the view that food cues will receive prioritized processing that comes at the cost of lowering people’s ability to identify subsequently presented target stimuli (cf. de Jong et al., 2010), both restrained and unrestrained eaters showed a larger attentional blink with a food T1 as compared to a neutral T1. This finding is in line with the elaborated intrusion theory of desire, which proposes that attention for food cues can automatically trigger intrusive thoughts. These thoughts compete with concurrent cognitive tasks through retrieval of food-related information and its retention in working memory (Kavanagh et al., 2005). However, considering that the food-induced attentional blink was not especially pronounced in high restrained eaters, this effect seems not crucially involved in high restrained eaters’ difficulty to maintain their diet regimen. Under condition of a top-down search for food stimuli the differences between restrained and unrestrained eaters may well disappear. Consistent with such view it was observed that both restrained and unrestrained eaters show speeded detection of task-relevant food words compared to detection of neutral words (Hollitt et al., 2010).

Lastly, neither high nor low restrained eaters showed a lowered threshold for identification
of food cues. Disinhibited eating in restrained eaters can therefore not be explained by relatively efficient processing of food cues. It seems worth noting that here is a similarity between spatial attentional bias tasks and this type of RSVP trials (food T2 vs neutral T2. Both types of tasks examine efficient processing of food cues, which would facilitate the detection and/or identification of food cues. In the RSVP, it could be that a food T2, as compared to a neutral T2, would be detected more easily, profiting from privileged access to the cognitive system. The absence of a reduced attentional blink for food cues in the present temporal attention task seems therefore consistent with the previous failure to find differences between restrained and unrestrained eaters in spatial attention tasks such as the visual probe task and the exogenous cueing task (Ahern et al., 2010; Boon et al., 2000; Veenstra & de Jong, 2010).

In sum, in Chapter 2 it was shown that food stimuli caused an interference effect in high restrained eaters. This might be the consequence of attempts to suppress stimulus processing, but also reflect more elaborate processing, which is reflected in the associated temporal attention costs (De Ruiter & Brosschot, 1994). Food cues seem to benefit from prioritized access to limited cognitive resources, even if this processing priority interferes with their current task to identify pictures. If food cues remain relatively long in working memory, this may in turn give rise to craving and eventually lead to actual food intake. Also unrestrained eaters show distraction by food cues when task-relevant, but specifically restrained eaters show heightened distraction also when food is task-irrelevant. The finding that this happens even with task-irrelevant distracters, might imply that also in real life, food cues get non-intentional processing priority. So even when involved in activities outside eating, food cues might attract their attention, possibly leading to more elaborate processing, craving and eventually eating.

**Temporal attentional bias and anorexia nervosa**

Because restrained eaters and unrestrained eaters differed in task performance on the single target RSVP with a food picture as a distracter, it raises the question if AN patients, in contrast, are very efficient in preventing more elaborate processing of food stimuli. Attentional avoidance of high caloric food might help to decrease identification of food in the environment and/or more elaborate processing and thereby preventing food induced craving. If so, this would help AN patients to persist in their strict diet. Therefore, the study in chapter 3 tested the hypothesis that, for instance through prolonged starvation and repeated exposure to food without consequently eating, they are relatively insensitive to the attentional capture and are therefore not distracted by visual food cues. The study used a single target RSVP with food and neutral distracters, administered in a large group of AN patients.

However, results showed the opposite of what was expected. Also in AN patients, we found that, compared to the comparison group, target detection was hampered when it was preceded by a task-irrelevant food distractor. Thus, in contrast with the hypothesis, AN patients showed a similar bottom-up heightened attentional capture by visual food cues that interfered with their current task as we found in the group of unsuccessful dieters (high restrained eaters).
Integration of findings

The finding that the attention-grabbing power of food stimuli was not only present in restrained eaters, but similarly evident in patients with AN, seems inconsistent with the view that temporal attentional bias plays an important role in the pathogenesis of disinhibited eating. Because both groups show a similar temporal attentional bias for visual food stimuli, temporal attentional bias cannot help explaining why AN patients are so successful in maintaining their diet, whereas high restrained eaters typically fail to do so. The only conclusion that can be drawn is that for both successful and unsuccessful dieters, food cues are apparently very salient.

The available findings are silent with regard to the processes underlying the heightened attentional capture of food cues. It might reflect craving and hedonic motivation for food, in line with earlier studies that link temporal attentional bias and craving (Neimeijer et al., 2013; Piech et al., 2009; Schmitz et al., 2015), but the heightened attentional capture of food in successful as well as unsuccessful dieters might also be driven by threatening associations with gaining weight and losing control over eating (Werthmann et al., 2015). Previous studies on temporal bias indicate that also negative stimuli can capture and/or hold attention, and hamper ongoing task performance (e.g., Most et al., 2005; Olatunji et al., 2013; Verwoerd et al., 2010). When a fear-associated stimulus is detected, processing resources are automatically diverted from less salient cues to these feared stimuli to escape the danger as quickly as possible. Hyperattention to feared stimuli can, therefore, facilitate an early escape (Lavy et al., 1993).

The findings therefore fit well with the theoretical model of Field and colleagues (2016), which states that attentional bias arises from momentary evaluations of salient cues: If those cues are evaluated positively, negatively, or both simultaneously (ambivalence), then they will capture attention. It is the overall strength of that evaluation, rather than its valence, that determines the magnitude of attentional bias. The evaluation can vary from moment to moment depending on the current motivational orientation to consume the food or to refrain from consuming it (Field et al., 2016). The interindividual and moment-to-moment variation in restrained eaters might be large: Some restrained eaters might associate food especially with the positive aspects of eating, whereas for others, or at other moments, food is associated especially with the more negative aspects (e.g., of gaining weight). At any moment, food remains salient for restrained eaters. Earlier research on automatic associations in restrained eaters indeed found mixed results. Evidence for positive (Hoefling & Strack, 2008; Houben et al., 2010) and negative associations were found (Maison et al., 2001; Papes et al., 2009), and one study did not find a relationship between implicit measures of affective associations with high caloric food and restraint status (Roefs et al., 2005).

An attentional bias for food in AN might reflect fear of gaining weight or losing control over eating and could contribute to dietary restraint and (behavioural) avoidance of food stimuli. Additional factors, apart from heightened attention, seem to be involved in why restrained eaters enter the attentional bias-craving-eating cycle, whereas AN patients do not. Given the difference in actual eating behaviour, AN patients seem able to avoid further processing after initial attentional
capture, or they possibly have high top-down self-regulation skills to resist food-related short-term reinforcement. This is in line with the idea that bottom-up and top-down systems exert mutual influences on each other to determine whether thoughts and actions are engaged on adaptive goals, or on the processing of salient information that is unrelated to current goals (Mogg & Bradley, 2016).

**APPROACH AND AVOIDANCE TENDENCIES FOR FOOD**

Once food is in the centre of attention, food can be evaluated and the automatic behavioural tendency of approaching (or avoiding) the food can be activated. A tendency to automatically approach food might interfere with the deliberate intention to avoid food, whereas an avoidance bias would facilitate the diet intention. Therefore, the second cognitive motivational process that was studied in the current thesis, was this automatic approach bias for food. The Chapters 4, 5, and 6, presented studies on approach and avoidance tendencies in restrained eaters and AN patients.

**Automatic approach tendencies across situations**

A bias to approach food might play a role during a mealtime, where one has to choose what and how much to eat. Strong approach tendencies may then affect both the selection of food (e.g., approach tendencies may be stronger for high than for low caloric food items) and the amount of food-intake. If the goal is to restrict food intake, one can use all cognitive resources during a meal to regulate food intake in an attempt to achieve that goal. Whether automatic approach tendencies have a decisive influence on eating behaviour during a mealtime might therefore be dependent on the presence of a goal to restrict food intake and on the ability to act in line with that goal.

Automatic approach tendencies towards food might also be elicited in situations where food is irrelevant for one’s current task. For example, when passing a chocolate shop while shopping for new clothes, one might be seduced by the sight of chocolate. Outside a regular mealtime one is less actively thinking of the diet goal and consequently self-control might be less. So especially also when food is irrelevant for the current task and someone is doing something else, approach tendencies might be elicited when food is (unexpectedly) seen or smelled.

In an attempt to model both types of situations, two different computer tasks were used to measure automatic approach tendencies: An Affective Simon Task manikin version (AST) and the Stimulus Response Compatibility task (SRC). Because food is relevant for correct task performance in the SRC (i.e., the correct response is determined by the presence of food), this task models situations where the person is deciding what and how much to eat, such as during a mealtime. Especially when high caloric food items elicit strong automatic approach tendencies, this may influence people’s food selection that is inconsistent with their diet goal. Conversely, because food is irrelevant to correct task performance in the AST (i.e., the correct response is determined by another feature than food/non-food, such as top/side view perspective), this task models situations where the person is performing a different task, such as walking to work, but is tempted to eat, for example, by the smell of bread when passing a bakery.
Automatic approach tendencies in restrained eating

In Chapter 4, automatic approach tendencies were studied in restrained and unrestrained participants in a first attempt to directly compare both computer tasks in the context of food. Additionally, the influence of mood was examined. A neutral, positive, sad or stressed mood was induced, before the two approach avoidance tasks were administered. Afterwards, participants performed a bogus taste task to assess their level of food consumption to test whether there was a relationship between mood and actual eating, that is mediated by automatic approach tendencies towards food.

When in a positive mood condition and when food was task-irrelevant, restrained eating was associated with stronger approach tendencies toward high caloric food. This is in line with several studies pointing to increased food intake during positive emotions for eating- or weight concerned people (e.g., emotional and restrained eaters: Bongers et al., 2013; Yeomans & Coughlan, 2009). Positive emotions might lead to food indulgence, because happiness promotes impulsive and non-reflective processing. Especially in restrained eaters this may consequently lead to heightened approach behaviour inconsistent with conscious intentions (Schwarz & Bless, 1991). In other words, in restrained eaters, a positive mood might activate food-approach associations.

Following a negative mood induction, restrained eaters showed less approach bias than unrestrained eaters. This suggest that unrestrained eaters show a heightened approach tendency toward food when in a negative mood compared to a positive mood. Food can be consumed to provide comfort or distraction from negative emotions and when this happens regularly, it will become associated with aspects of the preceding negative state (Deutsch & Strack, 2006). So, results point to the conclusion that whereas for unrestrained people a negative mood leads to more approach tendencies, for restrained eaters a positive mood leads to heightened approach for food.

In line with their diet goal, restrained eaters showed, independent of mood, less approach towards food when food was task-relevant (as measured with the SRC), as compared to unrestrained eaters. These findings are consistent with previous research showing that restrained eaters displayed less approach bias when automatic approach tendencies were measured with a task in which food was a task-relevant feature (Fishbach & Shah, 2006). Approach tendencies as measured with the SRC appeared to be consistent with their diet goal.

Approach bias measured with the AST was not unconditionally related to restrained eating. The finding that the AST approach bias for high and low caloric food was not generally heightened in participants with relatively high scores on the Restraint Scale seems inconsistent with the previous finding that especially restrained eaters showed a heightened approach bias for food as indexed by the AST (Veenstra & de Jong, 2010). However, there were several differences between the study of Veenstra and de Jong (2010) and the current study, which might help explain the differences in outcomes. Most important, in the current study, participants underwent a mood induction prior to the AST, which influenced the approach bias. It could be argued that healthy people are by default in a positive mood, so this could explain why in both studies restrained eaters show heightened approach. One way to attain a more final conclusion is to directly compare restrained eaters after a positive mood induction versus no mood induction.
Automatic approach tendencies in anorexia nervosa

The finding that, at least in a positive mood, restrained eaters showed heightened approach tendencies if food is task-irrelevant, raised the question whether AN on the other hand might show reduced approach tendencies or even avoidance tendencies when exposed to food cues. In Chapter 5, automatic approach tendencies in AN versus a comparison group without an eating disorder were therefore studied using two types of approach-avoidance tasks. Results indicated that indeed AN patients show less automatic approach tendencies than the comparison group without an eating disorder both measured with the SRC (task-relevant) and with the AST (task-irrelevant). These findings are consistent with earlier studies using indirect measurement procedures to examine the more automatic approach responses toward food in AN (Paslakis et al., 2016; Veenstra & de Jong, 2011).

Specifically the SRC showed an independent relationship with the presence of AN, indicating that lowered automatic approach for food during a mealtime is most crucial in AN. The outcomes might help explain why AN patients, in contrast to restrained eaters, are able to comply to their deliberate intention to restrain from food even in situations where self-control is impaired and even when they are in a state of starvation. Perhaps as a result of repeated exposure to food without eating, food might have lost its incentive value in AN patients (Pinel et al., 2000). In support of this, AN patients showed a reduced self-reported desire for high-fat foods (Stoner, Fedoroff, Andersen, & Rolls, 1996). In addition, there is evidence indicating that also at the more automatic level AN patients failed to show positive affective associations with palatable food compared to a comparison group (Roefs et al., 2005).

With regard to low caloric food, AN patients showed heightened approach for task-relevant food pictures. An approach bias for low caloric food could help them with their diet intention, when combined with a lowered approach bias for high caloric food. In line with the idea that approach bias for low caloric food can protect someone from eating high caloric food, a study showed that specifically in individuals with low approach tendencies for healthy (low caloric) food, hunger positively predicted sweet consumption (Cheval, Audrin, Sarrazin, & Pelletier, 2017).

Integration of the findings

Integrating the findings of studies on approach tendencies in disordered eating, it seems that SRC performance is more consistent with participants’ diet goal than with their success in restricting their food intake. Whereas the unrestrained comparison groups (no diet goal), showed an approach bias, participants with a diet goal showed a reduced (restrained eaters) vs. no approach bias for food (AN patients). This might implicate that top-down processes (for instance their explicit diet goal) have an influence on the performance during the SRC task.

The finding that the unrestrained comparison group exhibited approach towards food, is reminiscent to findings of research in the context of alcohol. Social drinkers (as an analogue for unrestrained eaters) who did not have the goal to reduce their alcohol intake, showed an approach bias for alcohol as measured with the SRC (Field et al., 2011). Treatment seeking samples (as an
analogue for restrained eaters) might show, in line with their goal, reduced approach tendencies for alcohol when assessed with the SRC. However, especially those who fail to profit from treatment and are not able to resist the temptation to drink might show heightened approach tendencies on de AST. This might explain why restrained eaters might show an approach when food is task-irrelevant (as a model for temptations), but an avoidance bias when food is task-relevant. That however also the SRC seems to be related to actual behaviour is supported by the finding that specifically this task is uniquely related to the presence of AN.

It must be mentioned that results of Chapter 4 and 5 cannot be directly compared, because of the methodological differences. For instance, in the study on restrained eaters, various mood states were induced. The question remains whether AN patients also show differential effects with regard to their approach/avoidance tendencies in the AST, under influence of a positive or negative mood. One could speculate that, because AN is a highly impairing disorder and the comorbidity with depression is high, AN patients by default have a lowered mood state. If we assume that AN patients in general have a lowered mood, it can be concluded that they show the same pattern as restrained eaters in a negative mood. The effect found in AN patients is, however, even more pronounced than for restrained eaters in a negative mood: Whereas restrained eaters showed a reduced approach bias compared to the unrestrained comparison group, AN patients even showed an avoidance bias of high caloric food.

**The course of approach tendencies in anorexia nervosa**

A next question that raises after the findings in Chapter 5, is whether approach/avoidance tendencies change over time and whether recovery from an eating disorder critically depends on normalizing approach tendencies towards food. The study described in Chapter 6 therefore used a longitudinal design, in which approach tendencies for food and eating pathology of a large group of AN patients were measured at the moment of intake and at a fixed subsequent assessment at one-year follow up.

Results showed that automatic approach bias as measured with the AST generally recovered back to normal (i.e., to the level of the comparison group without an eating disorder), and patients also improved in terms of weight and eating disorder related cognitions. However, recovery of approach tendencies for high caloric food was not directly associated with a reduction of the eating disorders symptoms. This holds for at least the relatively short-term outcome, that is, one year after start of treatment.

Although treatment did not focus directly on changing automatic processes, the findings support the possibility that treatment does have an effect on approach tendencies, because there was no approach bias for high caloric food at T1, whereas there was at T2. The suggestion that treatment methods that focus on the more deliberate processes can be in itself also responsible for changing automatic processes, is in line with the idea that automatic processes may develop through the acquisition of new information that changes higher order beliefs, which in turn modify functionally-related lower order automatic processes (Mansell, 2000). Accordingly, although
automatic processes can operate without conscious control, voluntary processes can be responsible for changes in automatic processes. However, no final conclusions can be drawn at this point because it was ethically unacceptable to include a waitlist/no treatment control condition in this group of under-aged patients with a severe psychiatric disorder. Also learning/practice effects of the baseline measure on the follow up measure cannot be ruled out.

The finding that recovery of approach tendencies for high caloric food was not directly associated with reduction of the eating disorders symptoms was not in line with our expectations, but there are several possible explanations for this. First of all, in this study only the AST was administered. Initially, treatment focusses especially on normalizing eating pattern and weight restoration (Fairburn et al., 2008). In line with this, after one year, the frequency of eating the specific food items was increased. It might be that approach tendencies during a meal (as modelled by the SRC) are more associated with recovery since eating during mealtimes is a first step in treatment. It would be helpful doing further longitudinal research on this topic also with a task with food as a task-relevant measure and to test whether specifically change in the SRC index is associated with the initial reduction of eating disorder symptoms.

Secondly, it might be that the relationship automatic approach/avoidance tendencies and eating disorder symptoms is not linear. The treatment of AN is firstly focused on regaining weight and normalizing the eating pattern. By approaching the food the automatic tendency to avoid is then overruled by explicit actions (i.e., eating). By regularly doing this, automatic associations might eventually change as well. The absence of a straightforward relationship between improvement as indexed by body weight and eating disorder symptoms (EDE-Q) and improvement as indexed by increased approach tendencies towards food, may therefore imply that some patients have learned helpful cognitions but did not yet experience a change at the more automatic level. It could also be that the opposite is true: Automatic approach tendencies might change by normalizing the eating pattern in treatment, but concerns about eating, weight and shape (and thereby high EDE-Q scores) may first remain.

An important next step would be to find out whether patients in whom EDE-Q scores, but not approach tendencies toward food, changed in a favourable way, are at a relatively high risk for relapse. germane to this, a recent study in the context of speech anxiety showed that the strength of residual negative automatic associations with speaking in public after successful treatment had predictive value for the return of fear (Vasey et al., 2012). In analogy, absence of automatic approach tendencies toward food might be associated with a higher chance of a return of eating disorder symptoms over the course of multiple years.

In addition, it is known that eating disorders can change from one into another (Fairburn et al., 2003). For example, BN typically starts as AN or an atypical eating disorder (e.g., Sullivan, Bulik, Fear, & Pickering, 1998). Disorders that persist from adolescence to adulthood commonly change from a restricting AN picture to one more typical of BN, and could be viewed as a phase in the course of the eating disorder (Eddy et al., 2002). This transdiagnostic perspective on the maintenance of eating
disorders raises the question if automatic approach tendencies change during transitions between different eating disorders. Stronger approach tendencies at the onset of the eating disorder in an individual with AN could increase the chance of binging and thereby developing BN. One way to test this would be to follow eating disorder patients for a long period of time.

**COGNITIVE PROCESSES IN EATING DISORDERS: INTEGRATION OF FINDINGS**

To summarize, it was found that both restrained eaters and AN patients, showed heightened distraction by food cues. For both groups, the food stimuli appeared to be very salient, but the process underlying this saliency (e.g., craving / threat) remains unclear, and the finding does not explain the difference in eating behaviour between both groups. One reason that AN patients restrain from actual eating is that once food stimuli are detected, an automatic tendency to avoid food is activated, both when food is relevant and when food is irrelevant for their current task. Restrained eaters in contrast, show in a positive mood and when food is irrelevant for their current goals, a heightened approach bias for food, which may increase the chance of actual eating.

**Strengths, limitations and future directions**

A strength of this thesis is that the clinical studies all consisted of a relatively large group of AN patients. An important limitation is however the correlational nature of the studies. On the basis of the thesis, it cannot be determined whether the measured cognitive processes are a characteristic that is present before the onset of eating problems, or whether these processes are a symptom/expression of the eating disorder, and are thereby just epiphenomena. A critical next step is to test to what extent heightened approach tendencies play a causal role in the inability to maintain one's diet in restrained eaters and whether lowered approach tendencies are crucial in the persistence of AN.

There is evidence that a food-related approach bias can be successfully retrained, and that actual food consumption can be reduced following a cognitive bias modification (see for a review: Kakoschke, Kemps, & Tiggemann, 2017). A study using a cognitive modification procedure that trained participants to move a manikin towards or away from chocolate, had the predicted effect on approach bias: Participants trained to approach chocolate demonstrated an increased approach bias to chocolate stimuli whereas participants trained to avoid such stimuli showed a reduced bias (Schumacher et al., 2016). Further, participants trained to avoid chocolate ate significantly less of a chocolate muffin in a subsequent taste test than participants trained to approach chocolate. Thus, modifying automatic approach tendencies can not only have an influence on the tendencies itself, but also on actual behaviour. Perhaps, restrained eaters could benefit from a training designed to decrease their approach tendencies, whereas AN patients could be trained to increase their approach tendencies. One could argue that (absence of) approach tendencies during mealtime seem most crucial in whether a person is able to maintain a diet, so it seems a logical step to start with the SRC.

However, the application of such a bias modification training in AN patients, also comes with
several ethical and practical challenges, such as the potential risk of inducing binge eating. Another concern is that the training of approach tendencies without direct food consumption afterwards might contribute to a (further) extinction of the appetitive response towards food in anorexia patients, as an analogy with cue exposure in which the association between the presence of food and subsequent eating is attenuated (Jansen, 2016).

With regard to the studies on temporal attentional bias, in both studies the hunger scale was administered. There appeared to be no difference in hunger between restrained and unrestrained individuals. AN patients displayed less subjective hunger but a longer time since last meal, but the effects of the study remain the same when controlled for hunger. An interesting next question would be if temporal attentional bias varies under the influence of hunger for both groups. One would expect that hunger (caloric restriction) increases the incentive value and would thereby also increase the attentional bias, especially for restrained eaters. Earlier research using a RSVP in hungry and satiated participants indeed showed that hunger increased the attentional blink (Piech et al., 2009). To test this, a RSVP task can be administered in both groups directly after a meal, or after hours of abstinence. Because AN patients are in a chronic state of starvation one might expect that for restrained eaters, temporal attentional bias varies more under the influence of hunger than for AN patients. If hunger increases the attentional bias in restrained eaters, this might promote food intake, also the food that one has not planned to eat.

Further, a next step would be to determine whether temporal attentional bias decreases together with a decrease in dysfunctional eating behaviour. One could expect that when the eating pattern normalizes, food cues become less salient and thereby the temporal attentional bias becomes less pronounced. A remaining temporal attentional bias might hinder recovery. This might yield for both groups, although the underlying reason for the temporal attentional bias might be different. If the threat value of food gives rise to the temporal attentional bias for food stimuli, it may be important for recovery to reduce this threat value (cf. Olatunji, Armstrong, McHugo, Zald, 2013). Also, when temporal attentional bias is related to craving, it might be effective for normalizing the eating pattern to reduce the attentional bias (cf. Kemps, Tiggemann, Orr, Grear, 2014). Thus, normalizing the preoccupation with food might help to normalize the eating pattern.

Another limitation concerns the generalizability of the results. The clinical studies described in Chapter 3, 5, and 6, consisted of adolescents with AN. It could be that due to shorter durations of illnesses these automatic cognitive processes are less ingrained and therefore less pronounced than in adults. If so, then would automatic avoidance for food in adults with AN contribute even more to the persistence of AN. It is therefore important to also study automatic approach tendencies (using an AST ad SRC) in adult patients with AN.

With regard to the studies with restrained eaters, participants were predominantly young, highly educated, and were normal to slightly overweight, so it remains unclear whether results can be generalized to overweight participants or to a wider age range. It would be interesting to replicate the study in a more heterogeneous participant group.
CONCLUSION
The studies in the current thesis addressed the critical issue why some people are so proficient in restricting their caloric intake, whereas others systematically fail and overeat. In short, the research presented in the current thesis provided results that are consistent with the idea that both temporal attentional bias and differential approach-avoidance tendencies are involved in disordered eating. Both restrained eaters and AN patients showed a heightened attentional capture by food cues. This does not explain the differences between two groups, but temporal attentional bias might maintain both types of disordered eating. Especially when in a positive mood, restrained eaters showed heightened approach for task-irrelevant food stimuli, which might interfere with their diet goal. AN patients showed a reduced automatic approach tendency toward high caloric foods both when food was task-relevant and when food was task-irrelevant. Especially the reduced approach tendency when food was task-relevant and could not be ignored seemed the most critical characteristic of patients with AN. This reduced automatic approach tendency might help explain why AN succeed in complying to their intentional strategy to restrict their food-intake even in a condition of starvation. Although approach tendencies increased after one year, these were neither associated with concurrent change in eating disorder symptoms nor predictive for treatment success. Future research is needed to determine whether this also applies when food is task relevant and to determine whether normalizing automatic approach tendencies towards food predict treatment success on the longer term.