Chapter 5

Reduced Automatic Approach Tendencies towards Task-Relevant and Task-Irrelevant Food Pictures in Anorexia Nervosa

ABSTRACT

Objective. Anorexia nervosa (AN) patients are characterized by excessive and often life-threatening restriction of their food intake. A crucial question is how AN-patients succeed in maintaining this excessive and persistent food restriction even when resulting in a state of starvation. This study zoomed in on one possible mechanism, and tested the hypothesis that their ability to restrain from food might be facilitated by a reduced automatic approach tendency towards food, in both meal and non-meal contexts. To model a meal context, we used a paradigm in which food was task-relevant and could not be ignored. To model the seductive properties of food outside a meal context, we used a paradigm in which food was task-irrelevant and should thus be ignored for optimal task performance.

Methods. Two versions of a computerized approach-avoidance task were administered in adolescent restrictive AN spectrum patients (n = 63), and in a healthy comparison group of adolescents without eating pathology (n = 57): A Stimulus Response Compatibility (SRC) task with food as a task-relevant feature, and an Affective Simon Task (AST) with food as task-irrelevant feature.

Results. In both tasks, AN spectrum patients showed reduced approach tendencies for high caloric food stimuli compared to the comparison group. Only the SRC uniquely predicted the presence of AN.

Discussion. Reduced automatic approach tendencies towards food in both meal and non-meal contexts may contribute to AN-patients’ ability to persistently restrict their food-intake and may be critical targets for optimizing treatment.
INTRODUCTION

Anorexia nervosa (AN) is characterized by a low body weight and a fear of gaining weight. Patients show a disturbance in the way their body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial of the seriousness of the current low body weight (American Psychiatric Association, 1994). A critical question is how AN patients manage to succeed in maintaining a restrictive eating pattern, while they actually are in a state of starvation. Food generally has a high reward value, even more for people who have been deprived of food (Stroebe, Pories, & Aarts, 2008), yet individuals with AN manage to overcome the habitual biological drive to eat. One explanation for the successful restriction of food intake in AN patients might be that AN patients show a weakened automatic approach response towards food. This is consistent with studies on neurocircuit function in eating disorders suggesting that premorbid traits and brain functioning might underlie successful dieting behaviour (Kaye, Fudge, & Paulus, 2009). Subsequently, food deprivation in general and avoidance of high fat food specifically becomes a habit that is a self-reinforcing process: the habit is rewarding while requiring little cognitive effort (Walsh, 2013).

A critical situation in which food may typically elicit automatic approach tendencies is when people are exposed to food items during regular meals. During a regular meal, one has to choose what and how much to eat, and in such a context, automatic approach tendencies may affect both the selection of food (e.g., automatic approach tendencies may be stronger for high than for low caloric food items) and the amount of food-intake. However, in successful dieters, explicit exposure to food in the context of regular meals will probably activate their diet goal (Stroeb et al., 2008), which in turn may elicit automatic avoidance tendencies that override the common automatic inclination to approach food items. If, indeed, in the context of regular meals patients with AN, who can be considered extremely successful dieters, show reduced automatic food-induced approach tendencies or even avoidance instead of approach, this would help explain why patients with AN are so well-able to persist in restricting their food-intake.

An approach-avoidance task in which food is relevant to determine the correct response, can be seen as a model for approach-avoidance tendencies in a regular meal context. So far, no studies into automatic approach tendencies were conducted in AN patients in which food stimuli were included as a task-relevant feature. However, one study compared automatic approach/avoidance tendencies of dieters (participants who indicated that they sometimes engaged in dieting) and non-dieters in the general population (Fishbach & Shah, 2006, study 2). Outcomes showed that, consistent with their diet goal, dieters were indeed faster in pushing than pulling food words (avoidance) with a joystick in a computer task, whereas the opposite was found for the non-dieters (approach). However, this study has several limitations. First of all, the study relied on verbal stimuli which may be suboptimal to automatically activate approach behaviours as words typically lack the perceptual features of food that may elicit the seductive tendencies to approach food (cf. Huijding & de Jong, 2006). In addition, food words were compared to fitness words, so it remains unclear whether the effect was present due to avoidance of food, or approach of fitness, or both. Lastly,
because the study included non-clinical, healthy dieters, it is unknown whether similar or even stronger avoidance patterns may exist in AN patients. Therefore, in the present study we focused on a clinical group of AN patients and patients with Eating Disorder Not Otherwise Specified with specific characteristics of AN (from now on called AN spectrum patients). We used pictures of food (instead of words) to assess approach-avoidance tendencies in a task where food was task-relevant and could thus not be ignored. Thus, the first aim of this study was to test whether AN spectrum patients would show reduced automatic approach or even avoidance tendencies when food is used as a task-relevant feature (as a model of a regular meal situation) in the context of a speeded reaction time measure with the responses to a neutral control stimuli (office items) as the reference category instead of fitness-related stimuli.

Automatic approach or avoidance of food might not only be relevant in the context of common mealtimes, but may also exert its influence in situations where food is irrelevant for one’s current tasks. For example, while doing something else (e.g., reading a book), a person may be tempted to eat by the smell or the sight of particular food items. In AN spectrum patients, food may also fail to elicit an automatic approach response in situations like this. If so, this would render AN spectrum patients also less sensitive to the seducing properties of food stimuli outside the context of common meal times. In line with this idea, a previous study among adolescents found that individuals with AN indeed showed weaker automatic approach tendencies towards pictures of both high and low caloric food items than healthy controls in an approach avoidance task with food as a task-irrelevant feature (as a model of a non-meal context) (Veenstra & de Jong, 2011). A recent study among adult patients with AN showed a similar pattern that was most pronounced for high caloric food items. Whereas controls showed a clear approach bias toward food, AN patients did not show such a bias (Paslakis et al., 2016). Therefore, the second aim of this study was to test the robustness of these prior findings indicating that AN patients would show reduced automatic approach tendencies towards food when food is irrelevant for the task at hand (as a model of meal-irrelevant contexts). Moreover, the study examined to what extent reduced approach tendencies when food is task-irrelevant vs. task-relevant may independently contribute to the persistence of AN.

In sum, the current study was designed to enhance our understanding of why AN is so persistent, and how patients succeed in maintaining their dieting behaviour even in a condition of starvation. Therefore, we tested if AN spectrum patients (i) show reduced automatic approach or even avoidance tendencies for specifically high caloric food when food is a task-relevant feature; (ii) show reduced approach tendencies for specifically high caloric food when food is a task-irrelevant feature; and (iii) we examined to what extent both types of approach/avoidance tendencies are independently related to AN.

**METHOD**

**Participants**

Participants were female adolescents who were all admitted to a specialized Centre for Eating
Disorders of Accare, the Netherlands. For this study, we included a group of adolescent eating disorder patients with AN spectrum symptomatology \( (n = 63) \), using the Eating Disorder Examination (EDE: Bryant-Waugh et al., 1996; Decaluwé, 1999). Data collection started before the DSM-5 was published, so inclusion criteria of the DSM-IV were used (American Psychiatric Association, 1994). Next to patients who met all of the criteria of the restrictive type of AN \( (n = 33) \), we included patients who met most but not all criteria: patients with menses \( (n = 5) \), patients who were only mildly underweight, that is less than 15 % \( (n = 14) \), patients who were nonfat phobic AN \( (n = 2) \), and other partial \( (meeting 2/4 criteria) \) AN \( (n = 9) \) (cf. Thomas et al., 2009). Age ranged from 12 to 23. For the comparison control group, we selected healthy adolescents \( (n = 57) \) from secondary schools in Groningen.

**Materials**

**Computer tasks.**

The present study included two versions of a computerized speeded approach-avoidance task. The computer tasks were programmed in E-prime 2.0 (Schneider et al., 2002) administered on a laptop.

**Stimulus Response Compatibility task (SRC).** In the SRC version, the content of the picture (i.e., food/non-food) was a task-relevant feature (De Houwer et al., 2001). This task was designed to assess participants' automatic tendency to approach food when explicitly exposed to food items as during a common meal.

Each trial started with a 1000-ms presentation of a fixation dot. Next, a picture appeared in the middle of the screen, and a black manikin appeared above or below the picture. Participants had to move the manikin towards or away from the picture by (repeatedly) pressing the arrow buttons. The picture remained on the screen until the manikin had reached the picture or the edge of the screen. The participants were instructed to approach food (high caloric) and avoid non-food items in one block, whereas the response assignment was reversed in a second block (avoid food and approach non-food items). The order of the blocks was balanced over participants: Half of the participants had to approach food in the first block, and avoid in the second. For the other half of the participants, the instructions were reversed. A relatively strong automatic tendency to avoid food under these conditions would express itself in relatively fast responses and or less errors when the required response is to avoid the food items, together with relatively slow responses and/or more errors when the required response is to approach the food items. The SRC consisted of two practice blocks with four trials each (with stimuli not used in the test blocks) and two test blocks of 64 trials each. For each participant, trials were presented in a unique random order.

**AST.** In the Affective Simon task (AST) version of the approach avoidance task, the correct response was determined by stimulus features that were unrelated to the food/non-food content of the pictures, namely the orientation of the stimulus (top versus side view) of the object in the picture (De Houwer et al., 2001). This task might therefore be considered as a lab-model for approach-avoidance tendencies in situations where a person is not about to eat, but in which food may nevertheless automatically elicit automatic approach or avoidance response.
The AST consisted of a practice block of eight trials (with stimuli not used in the test blocks), followed by two test blocks of 96 trials each. Trials differed in stimulus type (i.e., task-irrelevant feature: high caloric, low caloric, and neutral), the side from which the photograph was taken (i.e., task-relevant feature: top-view vs. side view), and position of the manikin (i.e., above or below the picture). Each stimulus was presented four times in each block (top view: manikin above; top view: manikin below; side view: manikin above; side view: manikin below). For each participant, trials were presented in a unique random order. Half of the participants were instructed to move the manikin towards top views and away from side views, and half of the participants were instructed to move the manikin towards side views and away from top views.

**Stimulus selection**

Stimuli for the AST and the SRC tasks were adapted from Veenstra and de Jong (2011) with some modifications. For both tasks, the stimuli represented eight high-caloric food items (pizza, croissant, chocolate, crisps, chips, ice-cream, biscuit, and toast with ham and cheese), and eight neutral stimuli (various office items). For the AST, two different pictures (380 × 285 pixels) were constructed for each of these items: one displaying the item from a top view and one from a side view. Although high caloric food items were most critical for the current study, the AST that was used in the previous study (Veenstra & de Jong, 2011), also contained low-caloric food items. For optimizing the comparability of findings we therefore decided to also include pictures representing low-caloric items in the current AST (strawberries, melon, carrots, cherries, cucumber, tomato, apple, paprika).

**Questionnaires**

*Eating disorder Examination interview (EDE-Q).* The child version of the Eating Disorder Examination Questionnaire (Fairburn & Bèglin, 1994) was administered, to allow for a comparison of severity of eating disorder pathology between AN spectrum patients and healthy controls.

*Hunger Scale.* The Hunger Scale (Grand, 1968) consists of four items (time since last eating, subjective hunger, estimate of the amount of favourite food able to eat, estimate of time until next expected meal).

**Procedure**

Approval for the study was given by the Medical Ethical Committee of the University Medical Centre Groningen, protocol number 2011.193. Patients in the study were diagnosed by the child version of the Eating Disorder Examination (Decaluwé, 1999). The child version was also used for the participants above 18, for uniformity reasons. The differences between the child and adult version are very little, only the wording is adapted to make it more suitable for adolescents. Before participants were scheduled for the assessment, both patients and their parents gave informed consent. Measurement took place before start of the treatment. The order of the computer tasks was counterbalanced over participants. Half of the participants received first the SRC and the other half first the AST. After the computer tasks, patients completed the questionnaires. Finally, weight and height were measured. Percentage underweight was derived from the 50th percentile of height and age (TNO, 2010).
Data reduction
Automatic approach tendencies might express themselves in response latencies and errors, and therefore both are used in the analysis. For the response latencies analyses, time until first key press was used. For the error-analysis, trials of which the first response was in the wrong direction were identified as errors. Before calculating mean reaction times, error trials and trials with response latencies below 200 ms and above 2000 ms were excluded from analyses (e.g., Veenstra & de Jong, 2010).

SRC and AST-effect scores were computed by subtracting error percentages and response latencies of approach trials from corresponding avoidance trials (cf. Rinck & Becker, 2007). Higher scores are indicative of an automatic tendency to approach rather than to avoid pictures, and negative effects reflect a tendency to avoid rather than to approach pictures. Subsequently, approach bias was calculated by subtracting SRC- and AST-effects for neutral pictures from respectively SRC- and AST- effects for high and low (for the AST) caloric food items, hereby controlling for non-specific differences in approach and avoidance tendencies. Higher scores on approach bias refer to a tendency to approach food compared to neutral pictures.

Analyses
To test whether AN spectrum patients show reduced automatic approach or even avoidance tendencies, for the SRC, independent samples $t$-tests were conducted to test the difference between AN spectrum patients and the healthy control group. To control for the possible influence of current hunger, an ANCOVA was done using time since last eating as a covariate (as it is the more objective measure for current hunger). For the AST, 2 (stimulus type: high caloric, low caloric) × 2 group (AN, control) repeated measures ANOVA’s were conducted with both errors and response latencies bias scores. Again, the same analysis was done with time since last eating as a covariate, to control for hunger. Relevant interactions were followed up by t-tests. To examine the independent predictive value of both tasks, a backward logistic regression analyses was conducted with AN (yes/no) as dependent variable and SRC and AST High caloric errors and response latencies bias scores as predictors.

RESULTS
Group characteristics
See Table 1 for a description of the participant characteristics and statistics of the between groups tests. In line with the inclusion criteria, AN spectrum patients had a higher percentage underweight (range 0-38 %), and higher EDE-Q scores. In addition, AN spectrum patients reported longer time since last eating, a longer time until expected next meal, but less subjective hunger, and lower amount of favourite foods that could be eaten right now.

Automatic approach tendencies measured with the SRC (food as task-relevant feature)

Error rates
See Table 2 for mean response latencies and error percentage of the SRC. There was no difference
between the AN spectrum patients and the control group $t(118) = 1.05, p = .30, d = .19$. Moreover, the bias scores for both the AN spectrum group, $t(62) = 1.30, p = .20, d = .33$, and for the control group, $t(56) = 0.19, p = .85, d = .05$, did not deviate significantly from zero (see Figure 1B).

**Response latencies.** Patients showed less approach tendencies for food than healthy controls, $t(118) = 2.30, p = .02, d = .42$. The effect remained stable when corrected for hunger, $F(1, 117) = 5.06, p = .03, \eta^2_p = .04$. A one sample t-test showed that the approach bias score differed from zero for controls, $t(56) = 2.76, p < .01, d = .74$, but not for AN spectrum patients, $t(62) = 0.17, p = .87, d = .04$. Thus, whereas controls showed an approach bias for high caloric food, patients showed no such bias (see Figure 1D).

**Automatic approach tendencies measured with the AST (food as task-irrelevant feature)**

**Error rates**

See Table 3 for mean response latencies and error percentage of the AST. The ANOVA showed a
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**Table 3. AST Percentage errors and response latencies as a function of group and stimulus**

<table>
<thead>
<tr>
<th></th>
<th>AN patients</th>
<th>Healthy controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HC</td>
<td>LC</td>
</tr>
<tr>
<td>Percentage errors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approach</td>
<td>16.90 (13.26)</td>
<td>14.30 (9.82)</td>
</tr>
<tr>
<td>Reaction time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approach</td>
<td>841 (246)</td>
<td>787 (229)</td>
</tr>
<tr>
<td>Avoidance</td>
<td>942 (198)</td>
<td>929 (212)</td>
</tr>
</tbody>
</table>

*Note. AST = affective Simon task, AN = anorexia nervosa, HC = high caloric, LC = low caloric.*

The main effect of stimulus type, $F(1, 118) = 6.74, p = .01, \eta^2_p = .54$, which was qualified by a stimulus type × group interaction, $F(1, 118) = 6.92, p = .01, \eta^2_p = .06$, indicating that the effect of stimulus type differed across groups (see Figure 1A). The effect remained stable when corrected for hunger, $F(1, 117) = 3.76, p = .05, \eta^2_p = .03$. There was no main effect of group, $F(1, 118) = 0.36, p = .64, \eta^2_p < .01$. To further interpret the interaction, follow-up t-tests were conducted. Independent samples t-tests showed that there was no significant difference between patients and controls for low caloric food, $t(118) = 0.89, p = .35, d = .16$, whereas there was a borderline significant effect for high caloric food, $t(118) = 1.92, p$
Automatic approach tendencies towards high caloric food tended to be reduced in AN spectrum patients compared to healthy controls. In addition, paired samples t-tests showed that AN spectrum patients showed stronger approach bias towards low caloric food than towards high caloric food, \(t(62) = 3.39, p < .01, d = .86\), whereas there were no such differences for the control group, \(t(56) = 0.03, p = .98, d < .01\). Finally, one sample t-tests were conducted to determine whether the bias scores differed from zero. For the control group there was no significant approach or avoidance bias in errors (no difference from zero), for neither high, \(t(56) = 0.71, p = .48, d = .19\) nor low caloric food, \(t(56) = 0.64, p = .53, d = .17\). However, for the AN spectrum patients the AST-index tended to be lower than zero for high caloric food, \(t(62) = -1.86, p = .07, d = .30\), and higher than zero for the low caloric food \(t(62) = 2.07, p = .04, d = .53\). Thus AN spectrum patients tended to show avoidance of high caloric food and approach towards low caloric food.

**Response latencies.** The same analyses were conducted for approach bias based on response latencies, and although the pattern of the interaction was in the same direction as in the error analysis, none of the effects in the ANOVA reached significance, all \(Fs(1, 108) < 2.04\), all \(ps > .16\), all \(\eta^2_p < .02\) (see Figure 1C).

### Independent predictive value of the AST and SRC

There was a significant relationship between the SRC and AST high caloric bias scores for both response latencies and error rates (see Table 4). To test to what extent SRC and AST high caloric indices were independently related to the presence of AN, a backward logistic regression analyses was done. Tests to see if the data met the assumption of collinearity indicated that multicollinearity was not a problem, SRC errors VIF = 1.12, response latencies VIF = 1.12, AST errors VIF = 1.18 and response latencies VIF = 1.19. In the regression analysis, only the SRC response latencies index remained as a significant predictor in the final equation, \(\chi^2 (1) = 5.55, p = .02\), indicating that only the SRC response latencies index had a unique relationship with the presence of AN, \(B = -.001, SE .001, p = .04\).

| Table 4. Correlations between SRC and AST HC indices and group (AN / control) |
|---------------------------------|----------------|----------------|----------------|
|                                 | Group | SRC errors | SRC RL | AST errors |
| **Group**                       |       |            |        |            |
| SRC errors                      | -.10  |            |        |            |
| SRC RL                          | -.21* | -.05       |        |            |
| AST errors                      | -.15  | .29**      | .15   |            |
| AST RL                          | -.15  | .16        | .29** | .29**      |

*Note. AN = anorexia nervosa, AST = affective Simon task, SRC = stimulus response compatibility task, HC = high caloric, RL = response latencies, * = \(p < .05\), ** = \(<.01\).*
DISCUSSION
The aim of the current study was to test whether AN-patients have reduced automatic approach tendencies towards food, and to examine whether this effect would be evident both in a paradigm in which food was relevant for correct task performance (SRC), as well as in a paradigm in which food was task-irrelevant (AST). In short, the overall pattern of results was very similar for both types of tasks and consistent with the hypotheses. In the SRC (response latencies), AN spectrum patients failed to show the automatic approach for high caloric food that was evident in the healthy controls. In the AST (error percentage), specifically AN spectrum patients showed avoidance tendencies for high caloric food. Only the SRC response latencies index showed an independent relationship with the presence of AN. The findings are consistent with neurocircuit research in AN indicating that patients with acute AN show amygdala and insula activation that may represent avoidance motivation for food (Friederich, Wu, Simon, & Herzog, 2013; Kaye et al., 2009).

Reduced automatic approach tendencies for food in AN
The current performance-based measures revealed that AN spectrum patients showed reduced automatic approach tendencies towards food compared to healthy controls. These findings are consistent with earlier studies using indirect performance-based measures to examine more automatic responses toward food in AN (Paslakis et al., 2016; Roefs et al., 2005; Veenstra & de Jong, 2011). These outcomes might help explain why AN patients, in contrast to unsuccessful dieters and people with obesity, manage to succeed in complying with their deliberate intention to restrain from food even in situations where others often fail (e.g., stress, feelings of hunger). Perhaps as a result of prolonged starvation and repeated exposure to food without eating, food might have lost its incentive value in AN patients (Pinel, Assanand, & Lehman, 2000). Therefore, individuals with AN may be relatively effective in ignoring the seductive properties of food items.

Task-relevant vs. task-irrelevant context
The results of both computerized performance-based measures indicate that AN spectrum patients show less automatic approach tendencies than healthy controls in two different types of situations. The SRC was included as an analogue for common meal time situations, whereas the AST was included as an analogue for situations outside a common meal (e.g., while working behind one’s desk). This is the first study showing reduced automatic approach towards food in situations where food is task-relevant (SRC), indicating that AN spectrum patients are better in not approaching food than healthy controls when explicitly instructed to do so and when food items cannot be ignored.

Moreover, the AST results confirm that automatic approach tendencies in AN are also weakened in situations where food is irrelevant for one’s current tasks (Paslakis et al., 2016; Veenstra & de Jong, 2011), possibly indicating a decreased sensitivity to the seductive properties of food when involved in tasks not related to food. Both types of reduced automatic approach tendencies towards high caloric food may facilitate the goal to restrict food intake across different kinds of situations. Given the quite small correlation between the AST and the SRC, the present data might be considered as consistent with the starting point that both computer tasks measure different, but related,
constructs, and that the distinction between food as a task-relevant versus task-irrelevant feature seems to matter. Only the SRC uniquely predicted the presence of AN. Thus, although in both conditions AN spectrum patients showed less approach, the current findings indicate that reduced approach when food is task-relevant, is most critical in AN.

Interestingly, for the AST, the between group difference was most pronounced in the error analysis, whereas for the SRC the difference was most pronounced when indexed by response latencies. One explanation for this finding might be that the task to approach or avoid food pictures (SRC) is easier than the task to approach or avoid top /side view pictures (AST). Indeed, it seems that overall fewer errors were made during the SRC than during the AST (see Table 2). This may have rendered the SRC less sensitive for finding differential effects in terms of error rates, but more sensitive for finding differential effects in terms of response latencies, whereas the opposite would yield for the AST. Consistent with the view that the AST would be relatively sensitive for finding differential effects in terms of error rates, it is more often reported that AST-effects were only evident as indexed by error rates (Vervoort et al., 2010). Furthermore, it was found that the SRC was more sensitive in finding group differences using response latencies (Field, Caren, Fernie, & De Houwer, 2011).

Although the differential AST-effect was only significant for the error-analysis, and the differential SRC-effect only for the reaction time analysis, the overall pattern of findings was very similar for both tasks and for both dependent variables, so no speed accuracy tradeoff seems present (see also Figure 1). For both tasks, the pattern of error indices suggests that AN spectrum patients show a tendency to avoid high caloric food, whereas controls do not show a bias towards or away from food. For both tasks, the pattern of response latency-indices suggests that AN spectrum patients do not show a bias, whereas controls show an approach bias. The lack of interference effects (influence of the content of the picture) in terms of differential response latencies for AN spectrum patients suggest that in both contexts AN spectrum patients seem very well able to deal with the distracting properties of the food stimuli and to just focus on the task demands. However, on some trials they fail and their automatic reaction to avoid food then leads to an error. Consequently, more errors are made on approach food trials than on avoid food trials compared to neutral approach and avoidance trials. The interference effect in terms of differential response latencies for the controls seems to indicate that they did (or could) not fully ignore the distracting properties of the food stimuli. Their pattern of response latencies suggests that it required cognitive effort to control their automatic (approach) responses, yet, apparently within the current task-context their cognitive control was sufficient to prevent the occurrence of actual erroneous responses.

**Future research**

A next question is whether automatic approach tendencies are subject to change (i.e., becoming more similar to the pattern of healthy controls) following successful treatment, or remain different from healthy controls and might then consequently be a risk factor for relapse. So far, only one study has explored the pattern of automatic approach/avoidance tendencies in the context of treatment.
This study showed that one year after the start of treatment, automatic approach tendencies for high caloric food measured with an AST-manikin, increased to the level for low caloric food (Neimeijer, de Jong, & Roefs, 2015). The pattern of approach bias during follow up looked similar to the pattern found in healthy controls which suggests that overall automatic approach towards food recovered back to normal after one year. However, this was not directly associated with actual improvement in terms of reduced eating disorders symptoms (EDE scores and underweight), nor were baseline levels predictive for the eating disorder symptoms at one year follow up.

An explanation might be that in general there is much room for improvement of eating disorder symptoms and many patients still received treatment at one-year follow up. Consequently, more time might be needed to find a direct association between automatic approach tendencies towards food and (improvement of) eating disorder symptoms. Furthermore, in this previous study only the AST was administered, whereas it might be that automatic approach tendencies during a regular meal (modelled by the SRC) are more important for recovery. This idea is supported by the finding that specifically the SRC is related to AN. It would be helpful doing further longitudinal research on this topic also with a task-relevant measure to gain more insight in the presence/absence of automatic approach tendencies in the context of AN and to test whether specifically change in the SRC index is associated with reduction of eating disorder symptoms.

To determine whether the absence of automatic approach is a causal factor in maintaining eating disorder symptoms, an important next step would be to directly manipulate it. A prior 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, Kemps, & Tiggemann, 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 treating both explicit processes (e.g., cognitive therapy) as well as automatic processes (e.g., enhancing the automatic tendency to approach food) eventually can lead to a more persistent modification of AN-patients’ inclination to restrict their food-intake.

Limitations

One limitation of the current study concerns the balanced order of the performance measures, to control for carry-over effects. It cannot be ruled out that the carry-over effect of the SRC on the AST was more pronounced than vice versa. Furthermore, we did not include low caloric food pictures in the SRC to keep the number of pictures that had to be approached and avoided within one block equal. It could however be that the absence/presence of low caloric food has influenced the automatic response towards high caloric food.
Conclusions

To conclude, in the current study we examined the relevance of reduced automatic approach tendencies toward food in AN spectrum patients. We differentiated between automatic approach tendencies when food was task-relevant (as a model of a common meal situation) and when food was task-irrelevant (as a model of being seduced by task-irrelevant food stimuli). Individuals with AN showed a reduced automatic approach tendency toward high caloric foods, both when food was task-relevant and when food was task-irrelevant. Yet, especially the reduced approach tendency when food was task-relevant and could not be ignored (as a model of a regular meal context) seemed the most critical characteristic of patients with AN. These reduced automatic approach tendencies might ‘help’ patients with AN to restrict their food-intake even in a condition of starvation.

Appendix A

Example of an AST-manikin trial