Self-control conflict in the eating domain

A cognitive, affective, and behavioral perspective

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Supplementary Materials 2

The Effectiveness of the Approach Avoidance Training in the Eating Domain Revisited

This chapter is based on:

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Given the rather inconsistent evidence for the effectiveness of the AAT-training in the eating domain so far (see Chapter 4, but also Dickson, Kavanagh, & MacLeod, 2016; Schumacher, Kemps, & Tiggemann, 2016; for a review see Kakoschke, Kemps, & Tiggemann, 2017), we conducted another study which aimed at providing a much stronger test of our hypothesis. We proposed two main reasons for why the training might have not been as successful as predicted. First, all our studies (as well as Dickson et al., 2016; Schumacher et al., 2016) were conducted with student samples, which implied that participants' Body Mass Index (BMI) was generally in the healthy weight range (average BMI across all our studies was 21.54, which falls in the normal category: 18.50 – 24.99). Previous research, however, suggests that eating related impulses might be stronger, more difficult to inhibit, and thus potentially more problematic in people with a higher BMI (Kemps & Tiggemann, 2015). Given that the AAT-training aims at reducing the impulse strength towards food cues, it is therefore possible that it might be more effective in a group that actually has strong impulses (for a similar reasoning see Eberl et al., 2013; Veling, Aarts, & Stroebe, 2013). Second, we (as well as Dickson et al., 2016; Schumacher et al., 2016) administered only one session of AAT-training. Whereas previous studies have made a similar choice regarding the amount of training sessions (Dickson et al., 2016; Fishbach & Shah, 2006; Schumacher et al., 2016; Wiers, Rinck, Kordts, Houben, & Strack, 2010), initial evidence suggests that administering more training sessions might strengthen the effectiveness of the AAT-training (Eberl et al., 2013). That prediction is fully in line with the idea that the AAT-training is based on associative learning processes (see e.g., Smith & de Coster, 2000).

In the present study we aimed to provide a strong test of the effectiveness of AAT-training in the eating domain by addressing those two major shortcomings of earlier work. Specifically, we recruited a large sample of participants with a relatively high BMI, and we administered 5 training sessions. The whole training program was administered online and participants were aware of the 'intervention' aspect of the study (and of the possibility of receiving sham training). Given the study was administered online, it was difficult to assess training-induced changes in eating behavior. We therefore chose to monitor the difficulty participants experienced when resisting their strongest (personal) temptations, or when making an alternative healthy choice (via self-report). Those difficulty measures, which have in the past been related to the experience of (self-control) conflict (Chapter 3; Kleiman & Hassin, 2011), also allowed us to learn more about the correlates of self-control conflict and the

degree to which it might be reduced as a consequence of AAT-training. What follows is an interim evaluation of the AAT-training program, as data collection is still running. The first set of analyses maps the correlates of the approach/avoidance bias with other individual difference measures at baseline. The second set of analyses investigates the effectiveness of the AAT training.

Method

Participants and Design

Three-hundred and five participants completed the assessment session of the current online intervention study (i.e., session 1: 256 women, 49 men, 1 missing; M_{age} = 39.69, SD = 12.70; time stamped at 04.04.2016). Of those participants, 72 completed all five training sessions up until the second assessment session (i.e., session 7: 63 women, 9 men; M_{age} = 46.08, SD = 13.31). [17] On average, the 7 sessions were 30.57 days apart (SD = 21.28, min = 6, max = 139). Participants were randomly assigned to one of four different conditions in the following design: 2(AAT: experimental vs. control) × 2(VPT: experimental vs. control). For the purpose of the present study, we will only focus on the AAT conditions (session 1: $n_{experimental}$ = 149 vs. n_{sham} = 157; session 7: $n_{xperimental}$ = 35 vs. n_{sham} = 37, at session 7 VPT conditions were equally distributed within AAT conditions, $\chi^2(1) = 1.96$, $p = .658$).

Participation was fully voluntary, but only possible if one was above 18 years old and not underweight (self-reported BMI > 18.50). The recruitment was exclusively done via online platforms (e.g., facebook; voedingscentrum.nl), on which participants could find a link to the hosting website www.impliciet.eu. Throughout the training program, participants received reminder emails that prompted them to complete the next training session. If participants had not completed a following session for 21 days despite being warned several times (after seven, ten, and 14 days), they were automatically excluded from the program.

Materials and Procedure

Participants approached the internet platform on their own accord. Before participants were officially assigned their personal user-information with which they could continue to log on to the training website, they were provided with some practical information about participation (e.g., how many training

[17] Participants could then complete 5 more training sessions before completing a third measurement session. Due to large drop-out we will, however, only analyze data up until the second assessment session at session 7.

sessions, how long the sessions last, which browser to use) and some general information about the goal of the study. Specifically, participants were told that the training is part of a larger research project which aims at changing eating related habits. Moreover, participants were informed that there was a 75% chance that they would be receiving the experimental version of the training (vs. control). Also, their height and weight was assessed, on the basis of which their BMI was calculated. Only if their BMI was 18.50 or higher could they commence the training.

Baseline assessment session. The first session was a baseline assessment session. First, participants were presented with a list of 18 broad, unhealthy food categories (e.g., chocolate, fried products, cakes) from which they had to indicate the five food categories they had most problems with in terms of controlling intake. Those five problematic food categories determined which type of training participants would follow. If they selected four or more sweet categories, they followed a training in which only sweet foods were included (+ drinks). The same applied when four or more savory foods were selected. If they selected two or three sweet or savory foods, they followed a mixed training in which half of the foods were sweet and half were savory (+ drinks). Moreover, those five most problematic food categories would return each session as part of the 'difficulty measure' (see below).

Questionnaires. Participants provided their demographic information (age, gender). Then, they completed the 13-item self-control scale (Tangney, Baumeister, & Boone, 2004). Participants read statements such as "I am good at resisting temptations" or "I say inappropriate things" and were asked to indicate the extent to which this statement was applicable to them (1 *completely applicable* – 5 *not applicable at all*). All items were then averaged (reverse scored when necessary), so that higher scores indicated higher levels of self-control (α = .76). Next, they filled in the six-item concern for dieting subscale of the restrained eating scale (Herman & Polivy, 1980). Example items are "I feel guilty after I have eaten too much" and "I spend too much attention and time on eating", and participants rated their endorsement on a scale from 1 to 5 (with the exception of one item, which was rated on a 4-point scale), with higher scores representing more endorsement. Answers were averaged, so that higher scores indicated greater concern for dieting (α = .66). Additionally, two items measured the importance of people's dieting goal (r = .52) and their perceived dieting success (α = .64; Meule, Papies, & Kübler, 2012). Again, higher scores represented higher endorsement.

Finally, participants' eating-related self-efficacy was assessed (based on Clark, Abrams, Niaura, Eaton, & Rossi, 1991). Participants were presented with 21 statements which all started with "I can resist eating…" and which were completed with, for example, "…when feeling depressed" or "…when I watch TV". Participants reported their level of endorsement on 5-point scales, with higher scores indicating higher perceived self-efficacy concerning their eating behavior in that particular situation. We calculated an overall self-efficacy score including all items (α =.83).

AAT assessment. Once participants had filled in all questionnaires, they were introduced to the approach avoidance task. Participants read that they are going to see pictures on the screen, one at a time, which could either be leaning to the left or to the right. Each time the picture leaned to the right they were supposed to pull it towards them by pressing and holding the 'u' button (until the picture had fully 'zoomed in'; approach trial), when it leaned to the left they were supposed to push it away by pressing and holding the 'n' button (until the picture had fully 'zoomed out'; avoid trial; orientation to movement to key combinations were counterbalanced between participants). The zooming function was added to enhance the experience of approaching or avoiding the stimuli (Rinck & Becker, 2007). They were reminded to react as fast and as accurately as possible, and were told they would receive accuracy feedback throughout the task.

The task started with a practice block of 12 trials (50% approach trials) in which participants responded to the orientation of grey squares (same size as pictures in the assessment phase). Then they continued with the approach avoidance assessment, which consisted of 160 trials (50% approach trials) half of which displayed pictures of healthy food (e.g., fresh blueberries) and half of which displayed pictures of unhealthy food (e.g., chocolate bar, see Figure SM2.1). Participants approached and avoided an equal amount of healthy and unhealthy pictures. Half-way participants could take a self-timed break. Each experimental trial started with the presentation of a fixation cross (displayed for 500 to 1000 ms, uniformly distributed), which was immediately followed by the presentation of a food picture (time-out after 3000 ms). Once participants pressed the button, the picture zoomed in or out (for 750 ms) depending on trial type. There was an intertrial pause of 500 ms.

Training sessions. Participants completed five training sessions between the baseline and the second assessment.

Difficulty measure. At the beginning of each training session, participants were asked to think back to the last three days and to indicate the

degree to which they found it difficult to resist each of the five food categories they had rated as most problematic at the baselines assessment session (0 *not difficult at all* – 100 *very difficult*). For each session, difficulty scores were averaged to arrive at a general difficulty-to-resist score per training session. Similarly, they were also asked to rate the difficulty with which they choose a healthy alternative (0 *not difficult at all* – 100 *very difficult*).

AAT training. The approach avoidance training started with the same instructions as in the baselines assessment session. Participants first completed 12 practice trials (see AAT-assessment) and 192 'training' trials. In the experimental condition, participants avoided (approached) all unhealthy (healthy) food pictures. In the control condition, participants avoided (approached) the same amount of unhealthy and healthy food pictures (see AAT assessment).

Second assessment. After five training sessions which participants completed at their own pace at home, participants went through the second assessment phase. For the purpose of the present study, we will restrict the description of the measures to those central to our analyses: The difficulty measure as completed in all training sessions (see above), and the AAT assessment as completed in the baselines assessment session (see above). Importantly, the AAT assessment was identical in terms of task parameters, but half of the pictures participants responded to were taken from earlier training sessions, whereas half were novel.

Picture set. The pictures for all assessment and training sessions were taken from an especially developed and validated picture set, the Amsterdam Food Picture Set (AFPS; Becker, Watson, & Wiers, 2016). The total picture set consists of 540 unique pictures displaying 80 food items, and 10 drinks items from six different angles. Half of the food items displayed relatively more healthy food (lower calories per 100g) and the other half relatively more unhealthy food. Half of each category displayed sweet foods, half displayed savory foods. Each healthy food item was matched with an unhealthy food item in terms of visual appearance and food type (e.g., snack, lunch). For example pictures, see Figure SM2.1.

Results

Baseline Assessment

In the first set of analyses we explored how people's approach bias for unhealthy and healthy food was related to the other individual difference measures assessed at baseline. The AAT data was prepared as follows: We

excluded all incorrect trials, and trials in which reaction times (RTs) were smaller than 200 ms or three *SD*s below participants' mean RTs, or larger than 2000 ms or three *SD*s above participants' mean RTs. We then calculated for each participant an approach bias score for unhealthy foods (unhealthy avoid – unhealthy approach; the higher the number the stronger the approach bias), and an approach bias score for healthy foods (healthy avoid – healthy approach). Participants whose average accuracy was below 70 % were excluded from analyses (n = 5).

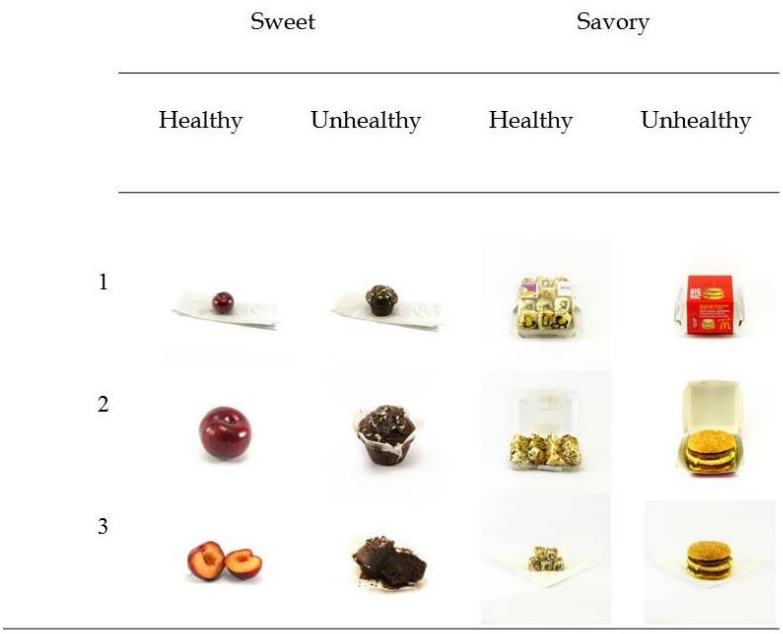

Figure SM2.1. Examples of the Amsterdam Food Picture Set (AFPS; Becker et al., 2016). Pictures displayed either sweet or savory foods, half of which were healthy and half of which were relatively more unhealthy.

Approach bias. In the first set of analyses, we wanted to map the relationship between participants' approach bias for healthy and unhealthy foods with other individual difference measures at baseline. As can be observed in Table SM2.1, the only correlation that reached significance was the negative correlation between participants' approach bias for healthy food and BMI. This correlation suggests that the higher participants' BMI, the lower their approach bias for healthy food. The difference score between both bias scores did not

correlate with any of the measures, as was evidenced in additional analyses not displayed in the table.

We were also interested in whether or not participants had an approach bias for unhealthy or healthy foods at baseline. We therefore tested whether the two bias scores were significantly different to 0 (i.e., no bias at all), which was the case. Participants' bias score for unhealthy foods was significantly lower than 0, $t(299) = -4.15$, $p < .001$, as was their bias score for healthy foods, $t(299) = -.849$, $p = .009$. Those findings suggest that participants had an *avoidance* bias to both food types at baseline (similarly strong, $p = .141$).

Difficulty. We were also interested in the correlates of participants' mean reported difficulty to resist their five most problematic foods, and of their reported difficulty to make the healthy choice instead (assessed at session 2). As can be seen in Table SM2.1, both difficulty measures were negatively related to trait self-control, perceived success of self-control and eating-related self-efficacy. There was also a positive correlation between both difficulty measures and concern for dieting. Moreover, difficulty to resist was negatively related to age, whereas difficulty to make the healthy choice was positively related to BMI.

Training Effects

Neither at baseline nor at follow up did the two conditions in regards to any of the measures reported in Table SM2.1 (all *p*s > .05).

Approach bias. In order to investigate whether participants' approach bias for either food type changed over time as a function of condition, we conducted a 2(food category: unhealthy vs. healthy) × 2 (time: baseline vs. second assessment) × 2(condition: experimental vs. control training) mixed model ANCOVA, in which we also controlled for the total amount of elapsed time between the pre and the post measure and the other experimental condition (i.e., VPT). Neither the expected three-way interaction, $F(1, 68) = 0.30$, $p = .583$, $\eta_p^2 = .04$, nor any other effect reached significance (for descriptives see Table SM2.2). A comparable analysis in which we looked at the effect of condition on post-assessment bias scores while controlling for pre-assessment bias scores did not produce any significant results, either.

Difficulty. To test the effect of condition on participants' change in perceived difficulty to resist their strongest temptations vs. make the healthy choice instead, we conducted a 2(difficulty type: resist vs. make healthy choice) × 2(time: baseline vs. second assessment) × 2(condition: experimental vs. control) mixed model ANCOVA, controlling for total amount of days apart and

the other condition (i.e., VPT). Besides two main effects of difficulty and time, we also obtained a significant interaction between the two, $F(1, 66) = 5.16$, $p = .026$, $\eta_p^2 = .07$. Whereas it became easier over time to resist one's strongest temptations ($M_{pre} = 44.40$, $SE = 2.37$; $M_{post} = 34.39$, $SE = 2.78$), the perceived difficulty with which participants made the alternative healthy choice did not change ($M_{pre} = 48.77$, $SE = 3.04$; $M_{post} = 49.13$, $SE = 3.04$). This effect was independent of condition ($F < 1$).

Exploratory analyses. We then explored whether any of the individual difference measures were related to participants' change in response bias as a function of the condition they were assigned to. First, we found that neither self-control, nor goal importance or BMI (all centered) played a role in the predicted training effect. We then went on to test whether weight status influenced the training effect. For that we made two new variables based on participants' BMI, one coding for whether or not participants were overweight (BMI > 25), and another one coding for obesity (BMI > 30). Adding overweight status as an additional factor to the analysis, we obtained an interaction between time and overweight status, $F(1, 68) = 4.55$, $p = .037$, $\eta_p^2 = .06$. For participants who were not overweight ($n = 24$), their general approach bias for both food types decreased over time. For participants who were overweight ($n = 48$) there was not change in overall bias score. The analysis with obesity status as additional factor only produced a main effect of obesity status, $F(1, 68) = 4.86$, $p = .031$, $\eta_p^2 = .07$. Participants who were obese had a much stronger overall avoidance bias ($n = 15$; $M = -26$) compared to participants who were not obese ($n = 57$, $M = -2$). The large differences in sample size should, however, be taken into account when interpreting those results.

The only other two individual difference measures that had a significant effect in the model were eating-related self-efficacy and concern for dieting. There was an interaction between self-efficacy score, food category and time, $F(1, 68) = 4.942$, $p = .030$, $\eta_p^2 = .07$, which was, however, qualified by a trend for a four-way interaction with condition, $F(1, 68) = 3.54$, $p = .064$, $\eta_p^2 = .05$. In the training condition, there was a trend for a reduced approach bias over time, especially to unhealthy foods, but only for participants high in eating related self-efficacy. There were no effects of self-efficacy in the control condition. In a second model, concern for dieting interacted with time and condition, $F(1, 68) = 6.87$, $p = .011$, $\eta_p^2 = .09$. In the control condition, the overall bias score decreased over time for participants with a relatively low concern for dieting, and increased over time for participants with a relatively high concern

for dieting. There were no effects of concern for dieting in the training condition.

Table SM2.1.

Pearson Correlations Between all Baseline Measures (N = 300) and Descriptives.

	1	2	3	4	5	6	7	8	9	10	*M* (*SD*)
1. AB unhealthy	-										-14 (58)
2. AB healthy	.40***	-									-8 (57)
3. Age	.07	.02	-								39.75 (12.77)
4. BMI	-.07	-.13*	.26***	-							27.77 (5.23)
5. Self-control	-.01	.07	.18**	-.08	-						3.04 (0.57)
6. Concern f Dieting	-.02	-.04	-.11†	-.08	-.25***	-					2.72 (0.57)
7. Goal Importance	.02	.02	-.07	-.23***	-.06	.50***	-				5.48 (1.06)
8. Perceived Success	-.06	.04	-.07	-.29***	.36***	-.11†	-.06	-			2.87 (1.06)
9. Self-efficacy	-.02	-.04	-.03	-.10†	.39***	-.28***	-.17**	.29***	-		2.50 (0.33)
10. Difficulty Resist (Session 2, *N* = 205)	.08	.09	-.16*	-.11	-.19**	.24**	.11	-.27***	-.28***	-	46.44 (20.60)
11. Difficulty Healthy (Session 2, *N* = 205)	.03	.04	-.11	.16*	-.22**	.23**	.09	-.31***	-.23**	.58***	54.72 (25.98)

† $p < .1$ * $p < .05$; ** $p < .01$; *** $p < .001$

Table SM2.2.
Descriptive Statistics (M and SD) of Approach Biases for Unhealthy and Healthy Food Stimuli at Pre- and Post-assessment for Both Conditions Separately.

		Unhealthy Food		Healthy Food	
		Pre	Post	Pre	Post
Condition		*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Control	(*n* = 37)	-5 (60)	-11 (51)	-12 (58)	-16 (43)
Experimental	(*n* = 35)	3 (54)	-5 (43)	-3 (47)	-2 (38)

Note. Positive scores indicate an approach bias; negative scores indicate an avoidance bias.

Discussion

The goal of the present study was to further test the effectiveness of the AAT-training in the eating domain. Addressing weaknesses of earlier studies, we sampled a group of participants with a higher BMI, and we administered 5 training sessions. Results of this interim report showed that despite those methodological improvements, the predicted training effect did not emerge. Specifically, participants' approach bias for healthy and unhealthy foods did not change over time as a function of whether they were assigned to the training or control condition. Exploratory analyses suggested a trend for a training effect (reduced bias score for unhealthy foods over time in the training condition) only for participants high in eating related self-efficacy, but this analysis was based on a reduced sample and should therefore first be replicated before being interpreted as evidence for the effectiveness of the AAT-training.

We were also interested in whether the AAT-training would reduce the difficulty with which participants resisted their strongest temptations, and with which they made alternative healthy choices. We did indeed find that resisting temptations got easier over time, but this was independent of whether one was assigned to the training or control condition. Interestingly, making healthy choices remained as difficult at second assessment as it was at baseline. Together, those results suggest that following five sessions of AAT-training neither influences impulsive responding to food stimuli, nor does it influence

the difficulty with which participants resist temptations or with which they make alternative healthy choices. The present study therefore replicates the findings of our three earlier single session studies. Importantly, simply taking part in the study (in either of the two conditions) seemed to have some positive effects, which suggests that not the training per se but merely being involved in the training program might already be helpful for people who aim to improve their eating behavior.

Some other interesting findings should be mentioned. First, there was an overall avoidance bias for unhealthy and healthy food at baseline. Whereas this might be surprising, this is actually in line with our findings in Study 4.3 in which we also found negative bias scores for food stimuli. This could suggests that our participants 'disliked' (i.e., have a negativity bias for) all foods. Such an interpretation would, however, be at odds with the notion that people struggle with their eating behavior because of a strong approach biases to unhealthy foods. Second, we also looked at whether variations in the difficulty with which participants resist their strongest temptations or with which they choose a healthy alternative correlated with any individual difference measures. From the baseline ratings we could see that resisting temptations was easier for participants of older age, higher trait self-control, higher perceived self-control success, and higher self-efficacy. It was more difficult though for participants with a high concern for dieting. Conversely, choosing a healthy alternative was easier for participants with higher self-control and perceived self-control success ratings. However, the higher participants' concern for dieting or BMI, the more difficult healthy choices were. That pattern of results is very much in line with earlier work showing that people with high trait self-control (or related concepts) experience less self-control conflict (Hofmann, Baumeister, Förster, & Vohs, 2012).

Limitations and Future Directions

One potential explanation for not observing a training effect might be that the analyses of the training effect were based on a relatively small sample. As the current study is still running, we will have to see whether a training effect will emerge in a bigger sample. Moreover, the control condition in our study was a sham training (i.e., participants approached and avoided equal amounts of unhealthy and healthy food pictures). Other studies that do find significant training effects in the eating domain have used a less conservative control group, namely an approach training (i.e., participants approach all unhealthy foods). Such a counter-training control group is, however, not appropriate in

the context of an intervention study as ours. And finally, maybe the AAT-training might be more effective if it is embedded in a more elaborate intervention program (e.g., including CBT or motivational interviewing, see Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013). Such a more holistic approach could not only increase participants' general motivation to adhere to the program, it could also help participants to develop a larger set of strategies that can be used to resist temptations.