Approach–avoidance tendencies towards food: Measurement on a touchscreen and the role of attention and food craving

Adrian Meule\textsuperscript{a,b,*}, Anja Lender\textsuperscript{a,b}, Anna Richard\textsuperscript{a,b}, Radomir Dinic\textsuperscript{c}, Jens Blechert\textsuperscript{a,b}

\textsuperscript{a}Department of Psychology, University of Salzburg, Salzburg, Austria
\textsuperscript{b}Center for Cognitive Neuroscience, University of Salzburg, Salzburg, Austria
\textsuperscript{c}Department of Multimedia Technology, Salzburg University of Applied Sciences, Puch, Austria

\textbf{A R T I C L E  I N F O}

\textbf{Keywords:}
Approach
Avoidance
Food
Chocolate
Craving
Eating behavior

\textbf{A B S T R A C T}

Automatic approach tendencies are often assessed with joystick-based approach–avoidance tasks (AATs). In line with similar studies, we have previously shown that individuals show an approach bias towards palatable food only when picture valence (i.e., the content of the picture) is relevant for task performance. In the current study, we adapted this joystick-based AAT for implementation on a touchscreen, which required participants to perform more naturalistic approach–avoidance movements. One-hundred and seven participants (73% female) were instructed to pull or push pictures of chocolate-containing food and non-edible objects either based on picture content (content group, \(n = 36\)), frame color (frame group, \(n = 35\)), or a symbol superimposed in the center of each picture (symbol group, \(n = 36\)). No approach bias towards food was detected in either group. However, trait chocolate craving and a general preference for chocolate related to higher approach bias scores only in the content group, but not in the frame or symbol group. In addition, only participants in the content group reported increases of current chocolate craving throughout the task. While this touchscreen-based AAT did not replicate results from its joystick-based equivalent, results are in line with suggestions that explicit task instructions may be preferred over implicit task instructions (i.e., when participants have to respond to valence-irrelevant features). Future studies may examine if and how touchscreen-based AATs can be implemented for modifying approach tendencies towards unhealthy food and, ultimately, reducing consumption of these foods.

\textit{1. Introduction}

Stimuli with a positive valence facilitate approach behavior while stimuli with a negative valence facilitate avoidance behavior (Solarz, 1960). Such approach–avoidance tendencies are usually assessed with computerized tasks. For example, joystick-based approach–avoidance tasks (AATs) are widely used. Here, participants are instructed to avoid certain stimuli by pushing a joystick and to approach certain stimuli by pulling a joystick (Rinck & Becker, 2007). These movements are usually accompanied by a visual zooming effect such that the picture shrinks when pushing the stimulus “away” and the picture enlarges when pulling the stimulus “towards” oneself. This zooming is thought to disambiguate the movement, that is, to clarify that joystick movements manipulate the virtual position of the stimulus and not the viewer’s position. Approach (avoidance) tendencies are inferred from reaction times when participants are faster when pulling (pushing) than pushing (pulling) the target stimuli or when pull (push) movements in response to target stimuli are faster than the corresponding movements in response to control stimuli, respectively.

To make the task more implicit, participants are often instructed to respond to a stimulus property that is unrelated to stimulus valence. For example, participants may be required to pull pictures in portrait format and push pictures in landscape format while picture content (e.g., alcoholic vs. non-alcoholic beverages) is irrelevant for performing the task correctly (Wiers, Rinck, Kordts, Houwen, & Strack, 2010). However, research has shown that approach–avoidance tendencies can be detected more reliably when the mapping rule is explicitly based on the relevant (e.g., disorder-related) than irrelevant stimulus feature (Kersbergen, Woud, & Field, 2015; Phaf, Mohr, Rotteveel, & Wicherts, 2014). In a study using pictures of palatable foods and non-edible objects, for example, we found that participants showed an approach bias towards food only when they were directly instructed to pull/push food/objects. Participants who responded to the very same pictures—but were instructed to pull/push pictures depending on the frame color (blue vs. green) or superimposed symbols (cross vs. circle)—did not exhibit an approach bias towards food (Lender, Meule, Rinck,
Brookmeyer, & Blechert, 2018). Moreover, while joystick-based AATs represent established and relatively well-validated tools for measuring approach-avoidance tendencies (e.g., towards alcohol), a critical examination of existing studies suggests that food-related AATs produced rather mixed findings. Specifically, the majority of studies that used joystick-based AATs did not demonstrate an approach bias towards (high-calorie) food relative to reactions to control stimuli or found such a bias only in certain subgroups of participants (Brookmeyer, Hahn, Reetz, Schmidt, & Friederich, 2015; Kakoschke, Kemps, & Tiggemann, 2015; Maas, Keijsers, et al., 2017; Maas, Keijsers, Rinck, Tanis, & Becker, 2015; Maas, Woud, et al., 2017; Machulska, Zlomuzica, Adolph, Rinck, & Keijsers, et al., 2017; Maas, Keijsers, Rinck, Tanis, & Becker, 2015; Machulska, Zlomuzica, Adolph, Rinck, & Keijsers, et al., 2017).

Amongst other explanations, one reason for these inconsistent findings may be that joystick movements do not mimic naturalistic approach and avoidance behaviors as the kinds of remote control operations afforded by joysticks represent a phylogenetically very recent development. Typical food intake settings feature reaching, grasping, and holding movements—including speeded and forceful pulling in case of competition for food. Thus, a laboratory implementation of a potentially evolutionarily shaped motor behavior should mimic such actions as close as possible.

As a first step in this direction, the current study examined the implementation of an AAT on a touchscreen monitor. For this, we adapted the task design of our previous study (Lender et al., 2018). Similar to that study, participants were either instructed to pull/push pictures of chocolate-containing foods and non-edible objects or were instructed to respond to valence-irrelevant features of these pictures. Yet, instead of moving a joystick, participants in the present study were instructed to move the stimuli towards or away from themselves by sliding their dominant hand on a touchscreen—similar to actual hand movements that are required to move real items (Fig. 1).

We expected to replicate results from our joystick-based AAT, that is, that participants would show an approach bias towards food only when instructed to respond to the content of the pictures, but not when instructed to respond to the irrelevant features. As previous joystick-based studies have found that a higher approach bias towards high-calorie foods relates to more frequent and intense food cravings in general (trait food craving) and stronger current food craving (Brookmeyer et al., 2015; Lender et al., 2018), we further expected that approach bias towards chocolate-containing foods would be associated with trait and state chocolate craving in the current study. Finally, we also explored whether approach bias towards chocolate-containing foods would be related to a general preference for chocolate (assessed through valence and palatability ratings of the food pictures) and whether performing the task would affect state chocolate craving and hunger differentially as a function of task instruction.

2. Methods

2.1. Participants

One-hundred and eleven individuals participated in this study. However, data of four participants had to be excluded from analyses. Thus, the final sample comprised n = 107 participants (72.9% female, n = 78). Mean age was M = 23.3 years (SD = 5.84, Range: 18–50) and mean body mass index was $M = 22.4\text{ kg/m}^2$ (SD = 3.11, Range: 17.2–24.6). According to the guidelines by the World Health Organization (2000), seven participants were underweight (6.5%), 84 participants had normal weight (78.5%), 12 participants were overweight (11.2%), and four participants were obese (3.7%). The majority of participants had German (60.7%, n = 65) or Austrian (38.3%, n = 41) citizenship, were university students (89.7%, n = 96), and were right-handed (92.5%, n = 99). Twenty-five participants (23.4%) indicated that they were currently restricting their food intake to control their weight and 70 participants (65.4%) indicated that they did so in the past.

2.2. Measures and materials

2.2.1. Sociodemographic and anthropometric data

Participants indicated their sex, age, body height and weight, nationality, occupation, and handedness. They also indicated whether they were currently dieting or had dieted in the past by answering (yes/no) the questions “Are you currently restricting your food intake to control your weight (e.g., by eating less or avoiding certain foods)?” and “Have you ever restricted your food intake to control your weight in the past (e.g., by eating less or avoiding certain foods)?”.

2.2.2. Approach-avoidance task (AAT)

The AAT included 16 pictures displaying chocolate-containing foods and 16 pictures displaying non-edible objects, which were obtained from the food-pics database (Blechert, Meule, Busch, & Ohla, 2014). Food and objects pictures did not differ in color, size, brightness, contrast, complexity, recognizability, and familiarity (all $t_{38} < 1.27$, $p < .22$). Each picture had a resolution of 96 dpi (619 × 469 pixels) and was edited to have four different versions: either a cross or a circle was superimposed in the center of the picture and the picture was framed by either a blue or green line. These pictures have been previously used in a joystick-based AAT (Lender et al., 2018) and can also be found in the supplementary material. In contrast to the joystick-based AAT, however, picture size did not change, that is, we did not employ a zooming effect because of the naturally occurring distance change in the current study.

The task was programmed in Unity (https://unity3d.com) and displayed on a 23-inch iiyama ProLite T2336MSC-B2 touchscreen monitor with a resolution 1920 × 1080 pixels. It consisted of two blocks, in each of which each picture was presented once (i.e., 16 × 4 food pictures and 16 × 4 object pictures), totaling $2 \times 128 = 256$ trials. Because of this arrangement, the number of images within each block were balanced regardless color of the frame (50% blue, 50% green), the symbol in the center of the picture (50% cross, 50% circle) and image content (50% food, 50% objects). Within each block, the order of picture presentations was randomized.

Participants were assigned to one of three groups, in each of which they had to respond to one image property by moving the picture to the bottom of the screen (towards themselves = pull) and to respond to another image property by moving the picture to the top of the screen (away from themselves = push; Fig. 1). Participants in the content group were instructed to respond to the content of the image (food vs. non-edible object). Participants in the frame group were instructed to respond to the color of the picture frame (blue vs. green). Participants in the symbol group were instructed to respond to the symbol in the center of the picture (cross vs. circle). After the first block, the instructions (e.g., pull food, push objects) were reversed (e.g., push food, pull objects).
performed the AAT, which included a brief practice block at the subscale which are scored from 1 = never to 5 = strongly agree. Internal reliabilities were \( \alpha = 0.923 \) at baseline and \( \alpha = 0.939 \) after the task. Internal reliabilities of the craving subscale were \( \alpha = 0.896 \) after the task. Internal reliabilities of the food craving and hunger before and after the AAT. The scale has 15 items which are scored from 1 = never to 6 = always. Internal reliability was \( \alpha = 0.941 \) in the current study.

2.2.4. Valence ratings
Participants rated the food and objects pictures by responding to the question “How pleasant/appealing do you find the object on the picture?” on a seven-point scale anchored 1 = not at all to 7 = very much. Internal reliabilities were \( \alpha = 0.915 \) (food) and \( \alpha = 0.853 \) (objects).

2.2.5. Food Cravings Questionnaire–Trait–reduced (FCQ–T–r)
The German, chocolate-adapted version of the FCQ–T–r (Meule & Hormes, 2015) was used to measure the frequency and intensity of chocolate cravings in general. The scale has 15 items which are scored from 1 = never to 6 = always. Internal reliability was \( \alpha = 0.941 \) in the current study.

2.2.6. Food Cravings Questionnaire–State (FCQ–S)
The German, chocolate-adapted version of the FCQ–S (Meule & Hormes, 2015) was used to measure the intensity of current chocolate craving and hunger before and after the AAT. The scale has 15 items (12 items for the chocolate craving subscale and 3 items for the hunger subscale) which are scored from 1 = strongly disagree to 5 = strongly agree. Internal reliabilities of the craving subscale were \( \alpha = 0.923 \) at baseline and \( \alpha = 0.939 \) after the task. Internal reliabilities of the hunger subscale were \( \alpha = 0.839 \) at baseline and \( \alpha = 0.869 \) after the task.

2.3. Procedure
The study was approved by the institutional review board of the University of Salzburg and through a local job advertisements website. A few days prior to the laboratory testing session, participants completed an online survey, which included the FCQ–T–r, picture ratings, and other questionnaires that are not reported here. In the laboratory testing session, participants signed informed consent, provided the sociodemographic and anthropometric information, and completed the FCQ–S. They then performed the AAT, which included a brief practice block at the beginning of the task consisting of six trials with neutral stimuli that were not used in the test blocks. Subsequently, they completed the FCQ–S again. Afterwards, participants completed other tasks that are not reported here. Participation lasted approximately 1 h and was reimbursed with course credits or €10.

2.4. Data analyses

2.4.1. Randomization check
Groups were compared regarding sex, nationality, occupation, handedness, and current and past dieting with Fisher's Exact Tests and regarding age, body mass index, palatability and valence ratings, FCQ–T–r scores, and FCQ–S scores at baseline with analyses of variance. We additionally report Bayes Factors (BF10), for which values > 1 indicate support for the alternative hypothesis over the null hypothesis. Bayes Factors were determined with JASP version 0.9.1 (www.jasp-stats.org) using the default priors.

2.4.2. Reaction times
Reaction time was defined as the time that participants needed to move the picture 200 pixels after the picture had appeared in the center of the screen. This threshold corresponded to moving the picture approximately 2 inches/5 cm on the touchscreen monitor (i.e., approximately 10% of the touchscreen monitor height of 20 inches/60 cm). Trials in which participants moved the pictures in the wrong direction (beyond the 200 pixels threshold) and trials with a duration of more than 3 s were excluded from analyses (9.65% of all trials). The number of valid trials did not differ between groups (Kruskal–Wallis Test \( p = .220, BF_{10} = 0.22 \)).

Bootstrapped split-half reliability estimates for each condition (pull food, push food, pull objects, push objects) were obtained using the average function of the R package splithalf (Parsons, 2018) performing 5000 random splits. Reliability estimates ranged between \( r = 0.84–0.89 \) (Spearman–Brown-corrected \( r_{SB} = 0.91–0.94 \) in the content group, between \( r = 0.84–0.88 \) (Spearman–Brown-corrected \( r_{SB} = 0.92–0.94 \) in the frame group, and between \( r = 0.87–0.93 \) (Spearman–Brown-corrected \( r_{SB} = 0.93–0.96 \) in the symbol group. To examine correlates of AAT performance, an approach bias score was calculated (approach bias score = [reaction time for pushing food – reaction time for pulling food] – [reaction time for pushing objects – reaction time for pulling objects]). Thus, positive values indicate an approach bias towards chocolate-containing food and negative values indicate an avoidance bias from chocolate-containing foods. For this approach bias score, reliability estimates using the difference-of-difference function of splithalf were \( r = 0.84 \) (Spearman–Brown-corrected \( r_{SB} = 0.92 \) in the content group, \( r = −0.24 \) (Spearman–Brown-
corrected $r_{pb} = -0.74$) in the frame group, and $r = -0.14$ (Spearman-Brown-corrected $r_{pb} = -0.47$) in the symbol group.

In line with joystick-based AAT studies (Rinck & Becker, 2007), median reaction times were calculated and were submitted to an analysis of variance for repeated measures with group (content vs. frame vs. symbol) as between-subjects factor, and direction (pull vs. push) and stimulus (food vs. objects) as within-subjects factors. We additionally report Baws Factors (BF), which are Inclusion Bayes Factors based on matched models, that is, they compare Bayes Factors of models that contain the effect to equivalent models stripped of the effect (Mathôt, 2017). Baws Factors were determined with JASP version 0.9.1 (www.jasp-stats.org) using the default priors.

2.4.3. Palatability ratings
To examine whether palatability ratings predicted approach bias scores as a function of group, a moderated linear regression model was calculated using PROCESS (Hayes, 2018) with palatability ratings as independent variable (mean-centered), group as multicategorical moderator (using indicator coding; 0 = content group), and approach bias scores as dependent variable.

2.4.4. Valence ratings
Differences in valence ratings for food and objects pictures were tested with a paired $t$-test. To examine whether valence ratings of the food pictures predicted approach bias scores as a function of group, a moderated linear regression model was calculated that paralleled the model for palatability ratings, except that valence ratings of the objects pictures were additionally entered as covariate.

2.4.5. Trait chocolate craving
To examine whether trait chocolate craving predicted approach bias scores as a function of group, a moderated linear regression model was calculated that paralleled the model for palatability ratings.

2.4.6. State chocolate craving
Increases in state chocolate craving throughout the task as a function of group were tested with an analysis of variance for repeated measures with group (content vs. frame vs. symbol) as between-subjects factor, measurement (baseline vs. after the task) as within-subjects factor, and FCQ-S craving subscale scores as dependent variable. To examine whether state chocolate craving at baseline predicted approach bias scores as a function of group, a moderated linear regression model was calculated that paralleled the models for palatability ratings and trait chocolate craving described above. A further moderation model tested whether approach bias scores predicted state chocolate craving after the task as a function of group while controlling for state chocolate craving at baseline.

2.4.7. Hunger
Analyses with the FCQ–S hunger subscale paralleled those for the FCQ–S craving subscale.

3. Results

3.1. Randomization check
Groups did not differ in sex, age, body mass index, nationality, occupation, handedness, current and past dieting, palatability and valence ratings, trait chocolate craving, and state chocolate craving and hunger at baseline (Table 1).

3.2. Reaction times
A main effect of direction ($F_{(1,104)} = 8.19, p = .005, \eta_p^2 = 0.073, BF = 4.19$) indicated that pull movements ($M = 607 \text{ ms}, SD = 94.5$) were faster than push movements ($M = 615 \text{ ms}, SD = 88.6$). Main
effects of group \((F_{(2,104)} = 21.4, p < .001, \eta^2 = 0.291, BF = 443327)\) and stimulus \((F_{(1,104)} = 27.7, p < .001, \eta^2 = 0.210, BF = 56.2)\) were qualified by a significant group \(\times\) stimulus interaction \((F_{(2,104)} = 40.6, p < .001, \eta^2 = 0.438, BF = 8626000)\). In the content group, participants reacted faster to food \((M = 649 ms, SD = 75.6)\) than to objects \((M = 687 ms, SD = 80.9; t_{(35)} = 1.54, p = .134, d = 0.073, BF_{10} = 0.53)\). In the symbol group, participants reacted faster to objects \((M = 609 ms, SD = 88.9)\) than to food \((M = 618 ms, SD = 86.1, t_{(35)} = 2.60, p = .013, d = 0.097, BF_{10} = 3.28)\). The direction \(\times\) stimulus interaction \((F_{(1,104)} = 1.94, p = .166, \eta^2 = 0.018, BF = 0.66)\) and the hypothesized group \(\times\) direction \(\times\) stimulus interaction \((F_{(2,104)} = 0.49, p = .614, \eta^2 = 0.009, BF = 0.17)\) were not significant. All means and standard deviations of reaction times are displayed in Table 2.

### 3.3. Palatability ratings

Mean palatability ratings of the food pictures were \(M = 4.85 (SD = 1.04, \text{Range: 2.19–7.00})\). In the moderation model, the group \(\times\) palatability ratings interaction was significant \((R^2 \text{ change} = 0.078, p = .015)\). Higher palatability ratings related to higher approach bias scores in the content group \((b = 39.8, SE = 12.1, p = .001)\), but not in the frame \((b = -5.82, SE = 11.1, p = .602)\) or symbol group \((b = -0.35, SE = 12.3, p = .978; \text{Fig. 2A})\).

### 3.4. Valence ratings

Participants rated the food pictures \((M = 4.76, SD = 1.05)\) as more positive than the objects pictures \((M = 3.55, SD = 0.89; F_{(2,106)} = 9.29, p < .001, d = 1.24, BF_{10} = 2.937e+12)\). In the moderation model, the group \(\times\) valence ratings interaction was significant \((R^2 \text{ change} = 0.088, p = .008)\). Higher valence ratings of the food pictures related to higher approach bias scores in the content group \((b = 41.0, SE = 11.5, p < .001)\), but not in the frame \((b = -5.75, SE = 11.8, p = .628)\) or symbol group \((b = -2.03, SE = 11.1, p = .856; \text{Fig. 2B})\).

### 3.5. Trait chocolate craving

Mean scores on the FCQ–T were \(M = 35.3 (SD = 13.9, \text{Range: 15–86})\). In the moderation model, the group \(\times\) trait chocolate craving interaction was significant \((R^2 \text{ change} = 0.085, p = .009)\). Higher FCQ–T scores related to higher approach bias scores in the content group \((b = 2.75, SE = 0.75, p < .001)\), but not in the frame \((b = -0.62, SE = 0.84, p = .462)\) or symbol group \((b = 0.04, SE = 1.15, p = .970; \text{Fig. 2C})\).

### 3.6. State chocolate craving

In the analysis of variance, the group \(\times\) measurement interaction was marginally significant \((F_{(2,104)} = 3.01, p = .053, \eta^2 = 0.055, BF = 1.19)\). In the content group, state chocolate craving scores increased from baseline \((M = 23.7, SD = 9.65)\) to after the task \((M = 25.1, SD = 10.8; t_{(35)} = 2.13, p = .040, d = 0.131, BF_{10} = 1.32)\). State chocolate craving scores did not change significantly in the frame group \((t_{(35)} = 1.11, p = .273, d = 0.109, BF_{10} = 0.32)\) and in the symbol group \((t_{(35)} = 1.58, p = .122, d = 0.106, BF_{10} = 0.56)\). The main effects of group \((F_{(2,104)} = 0.68, p = .507, \eta^2 = 0.013, BF = 0.47)\) and measurement \((F_{(1,104)} = 1.40, p = .240, \eta^2 = 0.013, BF = 0.30)\) were not significant. In the moderation models, state chocolate craving at baseline did not predict approach bias scores as a function of group \((R^2 \text{ change} = 0.022, p = .326)\) and approach bias scores did not predict state chocolate craving after the task as a function of group \((R^2 \text{ change} = 0.0003, p = .920)\).

### 3.7. Hunger

In the analysis of variance, a main effect of measurement \((F_{(1,104)} = 18.2, p < .001, \eta^2 = 0.149, BF = 391)\) indicated that hunger increased from baseline \((M = 7.32, SD = 3.02)\) to after the task \((M = 7.80, SD = 3.07)\). The main effect of group \((F_{(2,104)} = 0.49, p = .611, \eta^2 = 0.009, BF = 0.52)\) and the interaction group \(\times\) measurement \((F_{(2,104)} = 1.09, p = .339, \eta^2 = 0.021, BF = 0.20)\) were not
significant. In the moderation models, hunger at baseline did not predict approach bias scores as a function of group ($R^2$ change = 0.035, $p = .161$) and approach bias scores did not predict hunger after the task as a function of group ($R^2$ change = 0.003, $p = .388$).

4. Discussion

The current study aimed at translating a joystick-based AAT to a touchscreen-based AAT for the assessment of approach tendencies towards food. The task had high internal reliabilities (Parsons, Krujit, & Fox, 2018) and—in line with previous findings with joystick movements (Lender et al., 2018)—a main effect of direction was found such that pull (i.e., approach) movements were faster than push (i.e., avoid) movements. In contrast to our previous study, however, no approach bias towards food was found in either group. In the content group, participants reacted faster to food than to objects, but these reactions were independent of the type of movement (i.e., pull vs. push).

Although the finding of an approach bias towards food in the content group could not be replicated in the present adaptation for a touchscreen, we did find differential effects as a function of group that support validity of our design. In line with previous findings (Brockmeyer et al., 2015), higher trait chocolate craving related to higher approach bias towards chocolate-containing food (and, in fact, those with low trait chocolate craving showed an avoidance bias for chocolate-containing food). Thus, it appears that a more robust approach bias towards high-calorie foods can be found in certain subgroups of individuals (e.g., those with high trait food craving) while food approach tendencies can only be detected inconsistently in the general population.

The association between approach bias towards food and trait chocolate craving, however, was only found for individuals for which the content of the picture was relevant to the task (i.e., in the content group). This was further corroborated by similar associations with a general preference for these foods (i.e., palatability and valence ratings). Importantly, only approach bias scores in the content group proved to be reliable while internal reliability was unacceptable in the frame and symbol groups. Thus, we would argue that although the present results do not represent a direct replication of previous joystick-based studies, they are in line with results showing that instructions that make image valence task relevant seem to produce more reliable detection of approach tendencies and their correlates (Kersbergen et al., 2015; Lender et al., 2018; Phaf et al., 2014).

The auxiliary finding that state chocolate craving only increased in the content group, but not in the other groups, supports these observations. The lack of craving induction and of finding an approach bias (or respective correlations with trait chocolate craving) in the irrelevant task instruction conditions (in which participants attended to either frame colors or to overlaid symbols) point to the relevance of selective attention. Specifically, it seems that participants were able to successfully ignore picture contents and single out task cues (i.e., frames and symbols) in the service of efficient task performance. This again favors the use of relevant over irrelevant task instructions and dovetails with the ongoing debate on whether emotional material generally captures attention automatically or whether some degree of attention to the images is necessary for an observation of the downstream emotion-related processing bias (Carretié, 2014). Yet, neither momentary craving and hunger before the task nor task-induced craving and hunger increases were associated with approach bias scores in the content group. Given the associations found between approach bias and trait chocolate craving as well as palatability/valence ratings, this might suggest that correlates of approach-avoidance biases are more trait-like in nature and reflect overlearned stimulus–response associations rather than momentary oscillations in motivational state. Thus, future research is necessary that clarifies the relationships between trait and state food craving and approach tendencies towards food.

While the current findings indicate that our touchscreen-based paradigm is a valid measure of food-related approach bias, further studies may test whether the current paradigm can be generalized for measuring approach–avoidance biases to other stimulus classes and in other samples as well (e.g., approach bias to alcoholic beverages in heavy drinkers or to smoking stimuli in smokers). In addition, the current sample consisted of predominantly normal-weight women and group sizes were moderate. Thus, replication of the current results in larger and more representative samples is needed. Another future avenue would be to investigate the current paradigm in relevant clinical samples such as individuals with eating disorders and obesity. Furthermore, while subjective ratings of chocolate liking and craving provide support for validity of our task, future research need to include validation criteria other than self-report (e.g., actual food consumption). Finally, given that current food-related approach–avoidance trainings do not reliably change eating behavior (Aulbach, Knittle, & Haukkala, in press), future studies may examine the use of our more naturalistic touchscreen paradigm for modifying approach bias towards food and food consumption.

In conclusion, the current results are partially in line with previous joystick-based AAT studies and associations with approach bias-relevant constructs such as trait chocolate craving support validity of our touchscreen-based AAT. Future research may examine if and how such a touchscreen-based AAT may be employed as an approach bias modification training for reducing consumption of appetitive substances.

Acknowledgment

This work was supported by the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation program (ERC-SG-2014 639445 NewEat). The authors would like to thank Anna Ahamer, Max Bauer, Sarah Haslinger, Fabian Hirsch, Sandra Kreutzberg, Lina Lahmer, and Christian Seel for collecting the data.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2019.03.002.

References


