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Measurement of food-related approach–avoidance biases: Larger biases when food stimuli are task relevant

Anja Lender [a, b], Adrian Meule [a, b], Mike Rinck [c], Timo Brockmeyer [d], Jens Blechert [a, b, *]

[a] Department of Psychology, University of Salzburg, Salzburg, Austria
[b] Centre for Cognitive Neuroscience, University of Salzburg, Salzburg, Austria
[c] Behavioural Science Institute, Radboud University Nijmegen, The Netherlands
[d] Heine-University Düsseldorf, Medical Faculty, Department of Psychosomatic Medicine and Psychotherapy, Düsseldorf, Germany

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A B S T R A C T

Strong implicit responses to food have evolved to avoid energy depletion but contribute to overeating in today's affluent environments. The Approach–Avoidance Task (AAT) supposedly assesses implicit biases in response to food stimuli: Participants push pictures on a monitor “away” or pull them "near" with a joystick that controls a corresponding image zoom. One version of the task couples movement direction with image content-independent features, for example, pulling blue-framed images and pushing green-framed images regardless of content (‘irrelevant feature version’). However, participants might selectively attend to this feature and ignore image content and, thus, such a task setup might underestimate existing biases. The present study tested this attention account by comparing two irrelevant feature versions of the task with either a more peripheral (image frame color: green vs. blue) or central (small circle vs. cross overlaid over the image content) image feature as response instruction to a ‘relevant feature version’, in which participants responded to the image content, thus making it impossible to ignore that content. Images of chocolate-containing foods and of objects were used, and several trait and state measures were acquired to validate the obtained biases. Results revealed a robust approach bias towards food only in the relevant feature condition. Interestingly, a positive correlation with state chocolate craving during the task was found when all three conditions were combined, indicative of criterion validity of all three versions. However, no correlations were found with trait chocolate craving. Results provide a strong case for the relevant feature version of the AAT for bias measurement. They also point to several methodological avenues for future research around selective attention in the irrelevant versions and task validity regarding trait vs. state variables.

1. Introduction

Fast automatic action tendencies (i.e., an approach bias) towards unhealthy substances (e.g., alcohol, drugs, high calorie food) might play a significant role in craving for and consumption of these substances (Krieglmeyer, Deutsch, Houwer, & Raedt, 2010; Wiers et al., 2007). Presumably resulting from classical and operant conditioning processes, food cues can elicit strong approach behavior (Berridge, 2009; Jansen, 1998), which may contribute to increased food intake, and might thus also contribute to symptoms of eating and weight disorders (Brockmeyer, Hahn, Reetz, Schmidt, & Friederich, 2015a; Havermans, Giesen, Houben, & Jansen, 2011). According to dual process models, such automatic responses to food cues operate in an impulsive information processing system and are thus characterized by being rapid and difficult to govern by deliberate action (Bechara, 2005; Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013).

These automatic action tendencies towards cues of unhealthy substances have been measured by reaction time tasks such as the Approach–Avoidance Task (AAT). The AAT involves moving a stimulus on the computer screen either closer to oneself by pulling a joystick towards oneself or away from oneself by pushing the joystick away from oneself. To reinforce the meaning of joystick moves, one form of the AAT involves corresponding image zooms in response to joystick movements: the image grows for pull movements and shrinks for push movements. Each image type (e.g., food

* Corresponding author. University of Salzburg, Department of Psychology, Hellbrunner Straße 34, 5020 Salzburg, Austria.
E-mail address: jens.blechert@sbg.ac.at (J. Blechert).

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images and object images) is pulled on half of the trials and pushed on the other half of the trials. An approach bias is inferred if one picture type (e.g., food) is pulled faster than pushed (the same comparison for a control category controls for unspecific effects, e.g., that pull movements are generally faster). Two types of instructions have been used to let the participant know which images/trials to pull and which to push. In the *irrelevant feature* version, image content is irrelevant for the direction of joystick movements and participants respond to an content-independent feature (irrelevant versions are also sometimes termed 'implicit' or 'non-conscious'). For example, they might be instructed to pull pictures with a blue frame (regardless of content) and to push pictures with a green frame (regardless of content). In the *relevant feature* version, image content is the relevant feature: participants are required to classify the actual content of the picture to determine joystick movement direction (e.g., push joystick for food images, pull joystick for non-food images). Hence, the main difference between both task versions is where the participants' attention is directed: towards picture content (and categories, e.g., food vs. objects) or towards an image-irrelevant feature like frame color.

Irrelevant feature versions of the AAT are thought to minimize demand characteristics and to measure more implicit/automatic responses because a conscious evaluation of the picture content is avoided (Rinck & Becker, 2007). This version also allows for a flexible handling of contingencies: the 'standard' measurement of approach/avoidance bias requires that 50% of each stimulus class is pulled and 50% pushed. This contingency is changed in approach–avoidance trainings that intend to change existing biases, for example, 90% of foods might be pushed—supposedly reducing an approach bias—while 10% are pulled (reverse contingencies for the control category). While the same contingencies can be achieved in the relevant feature version of the AAT, the lack of a picture-independent, irrelevant response criterion requires repeated reversals of instructions (e.g., 80 trials of pulling foods and pushing objects alternating with 20 trials of pushing foods and pulling objects) and, therefore, requires relearning.

Thus, the majority of studies using the 'zoom AAT'—at least in the context of food or craved substances—relied on the irrelevant feature AAT version. However, this is in contrast with findings from a meta-analysis, which showed that the relevant feature AAT produces much stronger bias measures than the irrelevant AAT version (Phaf, Mohr, Rotteveel, & Wicherts, 2014). While this meta-analysis compared findings from different studies, only few studies have contrasted both versions directly. Using alcohol-related stimuli, Kersbergen, Woud, and Field (2015) found that the relevant feature AAT—but not the irrelevant feature AAT—was predictive of alcohol consumption. The relevant feature AAT directs the participants' attention to the stimuli whereas the irrelevant feature AAT directs participants' attention to the answer criterion signaling push or pull and, thus, creates competition between the two. The wider literature on whether emotional stimuli automatically capture attention is inconclusive: while the majority of studies show that emotional stimuli capture attention, many studies have also demonstrated effects of top-down (i.e., not stimulus driven) attention: when the task directs attention away from emotional stimuli (or when the competing task is very difficult) attentional capture effects decrease or disappear (Carretie, 2014). This is consistent with a limited capacity view on attention and it seems that biologically salient stimuli are not fully exempt from that.

Against that background, the present study compared relevant and irrelevant feature versions of the AAT in the food context. In the relevant feature AAT version, participants had to pull or push a joystick depending on whether the picture displayed chocolate-containing food or non-edible objects (*content AAT condition*). To gain more information specifically on the role of attention to food stimuli as opposed to response feature, we also implemented an irrelevant feature AAT condition, where participants responded to frame colors of the images (*frame AAT condition*) and an 'attention enhanced' condition in which the response feature was directly overlaid over the images (*symbol AAT condition*). In the latter condition, participants responded to small circles and crosses centered on the image (e.g., pull images with a circle, push images with a cross). Thus, while spatial attention could focus away from image content in the *frame AAT condition*, this was difficult in the *symbol AAT condition*. In addition, to gain knowledge on the criterion validity of the different versions of the AAT, auxiliary validation data were collected: besides state and trait chocolate craving, salivary flow during a chocolate exposure and actual chocolate consumption were measured as proxies for approach motivation towards chocolate. Differential correlations of these validation data with AAT biases in the three conditions could thus speak to their relative validity. Based on Phaf et al. (2014), we expected the largest AAT bias in the *content AAT condition*, followed by the *symbol AAT* and the *frame AAT condition*. Furthermore, based on Kersbergen et al. (2015), we also expected correlations with other appetitive behaviors (craving, salivation, consumption) to rank in that order, that is, the strongest associations were expected in the *content AAT condition*, followed by the *symbol AAT* and the *frame AAT condition*. Particularly state craving increases across the task might correlate with the AAT bias (Brockmeyer, Hahn, Reetz, Schmidt, & Friederich, 2015b). We also explored correlations in the whole sample between the AAT bias and appetitive behaviors to determine overall validity.

2. Methods

2.1. Participants

The study was approved by the institutional review board of the University of Salzburg. We recruited 117 individuals from university students and the general community in Salzburg, Austria. Participation was compensated with either course credit or € 10. Data from 13 participants were excluded due to technical problems ($n = 4$), non-adherence to or misunderstanding of task instructions ($n = 8$), and a high number of errors ($n = 1$) (>35% incorrect trials; cf. Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011), leaving a final sample size of $n = 104$ participants (81.7% female, $n = 85$). Mean age was $M = 23.2$ years ($SD = 6.02$, Range: 17–50) and mean body mass index (BMI) was $M = 21.7$ kg/m^2 ($SD = 2.71$, Range: 15.2–34.9).[1] Thirty-five participants (33.7%) self-identified as current dieters.

2.2. Materials

2.2.1. Approach–Avoidance Task (AAT)

The AAT included 16 pictures of chocolate-containing foods and 16 pictures of non-edible objects, which were obtained from the food-pics database (Blechert, Meule, Busch, & Ohla, 2014).[2] Chocolate and object pictures were matched with regard to their color (RGB), size, brightness, contrast, complexity, recognizability, and familiarity. 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 (Fig. 1).

[1] BMI data missing for one participant.

[2] Picture numbers in the food-pics database: 004, 079, 107, 111, 137, 140, 162, 163, 165, 168, 189, 286, 289, 465, 500, 510 (chocolate pictures); 1004, 1015, 1045, 1056, 1059, 1095, 1146, 1188, 1212, 1226, 1227, 1260, 1265, 1279, 1283, 1293 (neutral pictures).