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# Yum, cake!: How reward sensitivity relates to automatic approach motivation for dessert food images

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ABSTRACT

Previous research has used the Approach Avoidance Task (AAT) to measure individuals' implicit approach or withdraw tendencies to a variety of stimuli, including dessert foods, alcohol, and stimuli associated with specific phobias. Individuals exhibit relatively faster approach movements to appetitive stimuli (e.g., food) and relatively faster avoidance movements to fearful stimuli (e.g., spiders). We explored the validity of an adapted version of the AAT, the Dessert-AAT (D-AAT), by investigating how Behavioral Inhibition and Activation strength (BIS/BAS) predicted responses on the D-AAT. Faster approach movements to desserts tended to be related to BAS but not BIS. We found that the BAS Fun-Seeking subscale significantly drives the relationship between BAS and relative approach motivation for dessert images, providing preliminary evidence for the validity of the D-AAT. Results are discussed in terms of the revised Reinforcement Sensitivity Theory, and ideas for future research are offered.



## 1. Introduction

The Behavioral Inhibition System and Behavioral Activation Systems (BIS/BAS), as measured by Carver and White's (1994) BIS/BAS scales, have frequently been used to identify personality trait differences among various populations. BIS and BAS are two components to Gray's Reinforcement Sensitivity Theory (RST) (e.g., Gray, 1994). High BAS is associated with greater positive affective experience and more goal-directed behavior to appetitive stimuli. It appears to reflect activity of the brain's dopaminergic reward pathways (Gray, 1990). High BIS predicts increased feelings of anxiety and withdrawal behavior to perceived threat, which is thought to be largely controlled by serotonergic pathways (Gray, 1994). The present study investigated the relationship between BIS/BAS and implicit approach motivation for dessert food images.

The role of BIS/BAS has been studied to understand individual differences in a wide array of *explicit* behaviors, from risk taking on a gambling task (Demaree, DeDonno, Burns, & Everhardt, 2008) to college students' substance use patterns (Franken & Muris, 2006). However, the influence of BIS/BAS on *implicit* action tendencies is relatively understudied. Both theory and empirical research support the idea that some forms of positive affect encourage implicit "approach" behavior (e.g., Aarts, Custers, & Veltkamp, 2008). This is consistent with evolutionary perspectives of emotion and food selection, which suggest that the detection of larger portions of high-fat, energy-dense foods should elicit positive, approach-related affect and increased approach motivated behavior (Drewnowski & Rock, 1995).

In a series of studies, Gable and Harmon-Jones (2008) investigated the differing effects of low and high approach-motivated positive affect. In Study 1, participants viewed a film that showed either cats in humorous situations (low approach-motivation) or delicious desserts (high approach-motivation). Although ratings of positive affect were not significantly different between the two films, the dessert film evoked significantly higher "desire" ratings than the humorous film. These findings indicate that desire leads to approach-motivated positive affect associated with reward.

In order for something to be rewarding, two components are at play — "wanting," which occurs prior to the individual experiencing the approachable food, and "liking," which occurs after the individual has experienced the desirable food (Berridge, 1996). There are important differences between the "wanting" and the "liking" processes (Berridge, 1996). Wanting is associated with activation of the dopamine systems, whereas liking involves activation of the opioid and GABA/benzodiazepine systems (Berridge, 1996). The processes related to wanting may be linked with the approach-motivated positive affect components of reward and may exist at an *implicit*, non-conscious level (Berridge, 1996), which has important implications for the methodology used in this study.

The Approach–Avoidance Task (AAT) is a joystick task that assesses implicit approach or withdrawal biases toward various stimuli (Cacioppo, Priester, & Berntson, 1993). Previous research has found that people exhibit faster withdrawal (extension/push) movements in

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response to fearful stimuli (e.g., spiders) (Rinck & Becker, 2007) and faster approach (flexion/pull) movements in response to appetitive stimuli (e.g., alcohol; Wiers, Rinck, Kordts, Houben, & Strack, 2010), providing significant evidence for the utility of the AAT as a way to assess implicit motivation. However, no study has investigated the validity of an adapted version of the AAT, the Dessert-AAT (D-AAT). We tested the relationship between the D-AAT and BIS/BAS and hypothesized that individuals who scored higher on BAS would approach appetitive stimuli (e.g., desserts) quicker. No relationship between BIS and D-AAT performance was expected.

## 2. Method

### 2.1. Participants

One hundred and twenty-seven undergraduate students from a private Midwestern university participated. Data from 32 participants were excluded — 26 were non-native English speakers, 5 had possible eating disorders, and 1 was missing data for an entire measure. The remaining 95 participants had a mean age of 18.91 (SD = 1.09, range: 18–23) and consisted of 52 women and 43 men. In terms of race, 55 identified themselves as White, 30 as Asian, 5 as Black/African American, and 5 as Other. Data from error trials (3.4%) (and the repeated trial following the error) were removed prior to data analysis.

### 2.2. Procedure

Part of a larger study that involved other measures and an exercise intervention (not reported here), participants were informed about the procedures of the experiment and provided written consent. They then completed self-report questionnaires and participated in the D-AAT. Following task completion, participants were debriefed.

#### 2.2.1. Measures

1) *The Demographic Questionnaire* included information about age, gender, race, and ethnicity. Additional questions about dieting, the amount of time since the participant's last food consumption, and whether participants were native English speakers were also included. We eliminated participants who reported being nonnative English speakers because these individuals may differ in their desire for dessert foods that most Americans find very appetizing.
2) *The BIS/BAS scales* (Carver & White, 1994) were used to assess the degree to which people respond to rewards (BAS) and punishments (BIS). Participants responded to this 20-item scale using a four-point Likert scale. Participants' responses were used to score BIS, BAS Total, and three BAS subscales: Drive, Reward Responsiveness, and Fun-Seeking. Higher scores on BAS reflect greater responsiveness to rewards and higher scores on BIS reflect greater responsiveness to punishments. The internal consistency of the three BAS subscales and BIS range from 0.66 to 0.67 (Carver & White, 1994).
3) *The Eating Attitudes Test-26* (EAT-26; Garner, Olmstead, Bohr, & Garfinkel, 1982) is a 26-item questionnaire used to identify eating disorder risk. Participants responded to each item indicating the frequency of their feelings on a 4-point Likert scale. A total score of 20 or higher has been used to help identify people who are likely experiencing an eating disorder (Garner et al., 1982). Eating disorders can significantly alter people's motivation for food (e.g., Schienle, Schafer, Hermann, & Vaitl, 2009). Therefore, we used a total score of 20 or higher as an exclusion criterion. The EAT-26 has excellent test-retest reliability (Garner et al., 1982).
4) *The Satiety Labeled Intensity Magnitude* (SLIM; Cardello, Schultz, Lesher, & Merrill, 2005) measured participants' hunger/satiety levels. Participants placed a slash mark along one of 11 vertical lines corresponding to the description of their current hunger/satiety levels. Higher scores reflected greater hunger. The SLIM has excellent sensitivity and reliability (Cardello et al., 2005).
5) *The Dessert-Approach Avoidance Task (D-AAT)* is a measure of implicit approach motivation to dessert images. Using E-PRIME 2.0 Professional (Psychology Software Tools, Pittsburgh, PA), participants completed a version of the Approach–Avoidance Task (AAT) adapted from a previously used paradigm (Fleming & Bartholow, 2014). Participants learned to push or pull a joystick in response to the way a gray rectangle on a computer screen was tilted. If tilted 3° to the right, participants pushed the joystick. If tilted 3° to the left, participants pulled the joystick. Image tilt was counterbalanced across participants. When a participant pulled the joystick (approach movement), the image became larger, making it appear that it was moving closer. When pushing the joystick (avoidance movement), the image became smaller, making it seem like it was moving away. A 1 s interstimulus interval separated the images.

Participants then completed 160 trials where they were shown pictures of desserts and neutral items. Each type of image (dessert or neutral) was displayed equally often in push- or pull-format (stimuli were randomly presented without replacement). Forty neutral images were selected from the International Affective Picture System (Center for the Study of Emotion and Attention, 1999). Each neutral image was shown twice, once tilted right and once tilted left. These images were previously rated as neutral in valence (M = 4.97, SD = 0.249; 1 = extremely negative, 9 = extremely positive) and low in arousal (M = 2.91, SD = 0.585; 1 = extremely unarousing, 9 = extremely arousing).[1] Forty dessert images were obtained from Gable and Harmon-Jones (2008). Participants in their study rated (1 = really desired, 9 = did not desire) the dessert images as significantly more desirable (M = 4.12) than the neutral pictures (M = 7.15).

To be consistent with previous research using the AAT (e.g., Wiers et al., 2010), medians were used to summarize participants' performances on the D-AAT. Approach motivation to desserts relative to neutral objects (AppMot) was calculated using the following formula: $(RT_{DessertPush}–RT_{DessertPull}) – (RT_{NeutralPush}–RT_{NeutralPull})$ (e.g., Wiers et al., 2010). Higher scores indicate greater approach bias to dessert relative to neutral images.

## 3. Results

### 3.1. BIS/BAS and the D-AAT

To assess the relationship between BIS/BAS and relative approach motivation for dessert images (AppMot), Pearson correlations were conducted. Individuals high on BAS tended to be relatively more approach oriented to dessert images, $r(93) = 0.15$, $p = 0.072$ (1-tailed). There was no significant relationship between BIS and AppMot, $r(93) = 0.13$, $p = 0.202$.

Despite the nonsignificant relationship between BAS Total score and approach tendency for desserts (AppMot), we further assessed the relationship between BAS and AppMot by conducting additional correlations between AppMot and the three BAS subscales. BAS Reward Responsiveness and BAS Drive were not significantly related to AppMot ($ps > 0.74$). However, BAS Fun-Seeking was significantly and positively correlated with AppMot, $r(93) = 0.271$, $p = 0.008$.[2] Therefore, the positive but nonsignificant relationship between BAS and AppMot appears to be driven by BAS-FS (see Fig. 1).

[1] IAPS images included: 7000, 7001, 7002, 7003, 7006, 7009, 7010, 7012, 7014, 7016, 7017, 7018, 7020, 7021, 7025, 7026, 7030, 7031, 7034, 7040, 7041, 7045, 7050, 7052, 7053, 7056, 7059, 7061, 7062, 7090, 7100, 7160, 7161, 7170, 7175, 7185, 7186, 7190, 7211, 7235.

[2] Results were similar when including non-native English speakers. Specifically, there was no significant relationship between BAS and AppMot, $r(119) = .09$, $p = .35$, but the highly significant positive relationship between BAS-Fun Seeking and AppMot remained, $r(119) = 24$, $p = .007$.