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EMPIRICAL ARTICLE

CHILD DEVELOPMENT

Need for approval and antisocial behavior moderate the effect of socioemotional cues on adolescent girls' cognitive control

Haina H. Modi[1] | **Megan M. Davis**[2] | **Wendy Troop Gordon**[3] | **Eva H. Telzer**[2] | **Karen D. Rudolph**[1]

[1]University of Illinois, Urbana-Champaign, Urbana, Illinois, United States

[2]University of North Carolina, Chapel Hill, Chapel Hill, North Carolina, United States

[3]Auburn University, Auburn, Alabama, USA

Correspondence
Haina H. Modi, Department of Psychology, University of Illinois, 603 E. Daniel St., Champaign, IL 61820, USA.
Email: hainam2@illinois.edu

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Abstract

To examine whether need for approval (NFA) and antisocial behavior (ASB) moderate the effects of socioemotional stimuli on cognitive control, 88 girls (M_{age} = 16.31 years; SD = 0.84; 65.9% White) completed a socioemotional Go/No-go and questionnaires. At high approach NFA, girls responded more slowly during appetitive than control ($b = -8.80$, $p < .01$) and aversive ($b = -5.58$, $p = .01$) trials. At high ASB, girls responded more slowly ($b = -6.12$, $p = .02$) and less accurately (OR = 1.11, $p = .03$) during appetitive than aversive trials; at low ASB, girls responded more slowly during aversive than control trials ($b = -4.42$, $p = .04$). Thus, both context and individual differences influence adolescents' cognitive control.

Adolescence is a period of heightened sensitivity to emotional and social stimuli (Somerville, 2013; Steinberg, 2008). This acute sensitivity coincides with the protracted development of cognitive control systems, leading a subset of adolescents to experience emotion regulation difficulties (Schweizer et al., 2020). Previous work using laboratory tasks reveals age-related reductions in the interfering nature of socioemotional stimuli on cognitive control throughout child and adolescent development, with peak performance not occurring until early adulthood (Cohen et al., 2016; Tottenham et al., 2011). Relative to adults, adolescents show lower levels of cognitive control in the face of socially salient cues, such as happy (Cohen et al., 2016; Kwon et al., 2019; Somerville et al., 2011) and sad (Cohen et al., 2016; Dreyfuss et al., 2014; Hare et al., 2008) facial expressions, as well as images of social acceptance (Perino et al., 2016). Despite this normative adolescent sensitivity to socioemotional information, there are likely individual differences in the strength of this sensitivity, such that some adolescents may be more or less sensitive to these cues. This study examined two individual differences—need for approval (NFA) and antisocial behavior (ASB)—that may contribute to adolescent sensitivity to salient cues, as indicated by behavioral performance on a socioemotional cognitive control task.

Adolescent sensitivity to socioemotional cues

One unique aspect of the adolescent transition is a shift in motivation towards social connection and affiliation, specifically with peers (Nelson et al., 2016; Somerville, 2013). This shift is thought to strengthen the salience of socially relevant cues, a tendency known as social sensitivity (Somerville, 2013). Social sensitivity heightens the salience of social cues that aid in social development (e.g., establishing and maintaining

Abbreviations: ASB, antisocial behavior; BAS, behavioral activation system; BIS, behavioral inhibition system; ID, Individual differences; NFA, need for approval; RoS, Regions of Significance; RT, reaction time.

friendships). However, it also may heighten concerns about social evaluation and social standing (Brown & Larson, 2009; Somerville, 2013), potentially interfering with cognitive control (the ability to maintain attention towards goal-relevant information and to disengage from goal-irrelevant information; Braver, 2012). Although cognitive control improves with development, the context in which control is required may impact effective execution, such that socially relevant contexts may diminish control (Somerville & Casey, 2010; Tottenham et al., 2011). Sensitivity to social cues may challenge still-developing cognitive control systems and lead to reduced control and vulnerability within socially and emotionally charged contexts, particularly those involving socially appetitive (e.g., peer inclusion) and aversive (e.g., peer exclusion) cues.

Sensitivity to appetitive cues

There is a long-standing notion that adolescents disproportionately seek social rewards relative to other age groups (Brown & Larson, 2009; Steinberg, 2008). This approach behavior is likely guided by adolescents' amplified desire to gain social acceptance and affirmation from peers (Somerville, 2013). According to the social reorientation hypothesis, this shift occurs as a function of neuroplasticity in affective brain regions, which results in a refocusing of attention toward rewarding socioemotional information (Nelson et al., 2016). Although the salience of socioemotional cues allows adolescents to prioritize socially relevant goals, attentiveness to these cues may become problematic by impacting decision-making and adolescents' ability to resist peer-related cues. Indeed, adolescents tend to engage in more risky and impulsive behaviors and exhibit poorer cognitive control in the presence relative to the absence of peers (Breiner et al., 2018; Steinberg, 2008). Moreover, compared to both children and adults, adolescents exhibit more cognitive control failures in the context of appetitive cues (Cohen et al., 2016; Kwon et al., 2019) relative to neutral (Somerville et al., 2011) and aversive (Perino et al., 2016; Rogers et al., 2020) cues. Taken together, research suggests that adolescent goal-directed behavior may be compromised in the context of appetitive cues, which bias adolescents to approach incentives, even when those incentives may be risky.

Sensitivity to aversive cues

Changes in sensitivity to social threat also are common during adolescence, a developmental period marked by increasing concern about negative social evaluation and rejection (Somerville, 2013; Westenberg et al., 2004). Adolescents, but not adults, report lower mood following social exclusion (Sebastian et al., 2010), and several studies of cognitive control demonstrate age-related differences in sensitivity to aversive emotional stimuli in adolescents compared to other age groups. For instance, compared to adults, adolescents exhibit worse cognitive control (more errors on a Go/No-go task) in the context of aversive cues (fearful facial expressions, Cohen et al., 2016; angry facial expressions, Kwon et al., 2019) relative to neutral cues (calm facial expressions; Dreyfuss et al., 2014). Adolescents also are more distracted by fearful facial expressions than adults, resulting in longer reaction times (RTs) during cognitive control (Hare et al., 2008). Adolescent girls are especially distracted by aversive cues (as reflected in inhibitory control errors), more so than adolescent boys of the same age or males and females in any other age group (Cohen-Gilbert & Thomas, 2013). Collectively, these findings indicate that adolescents show a unique sensitivity to aversive cues that impair cognitive control.

Individual differences in social sensitivity: Need for approval

Although heightened during adolescence, social sensitivity helps guide emotion, cognition, and behavior within social interactions throughout the lifespan. According to the belonging regulation model (Gardner et al., 2005), individuals possess an internal system that monitors the extent to which one has fulfilled their innate need to experience significant and positive relationships with others. By providing feedback regarding one's level of belonging, this system serves as a guide to regulate behavior and shift attention towards socially relevant cues as needed. One specific manifestation of this internal regulatory system is reflected in NFA (Harter et al., 1996), a motivational striving that is conceptualized as the extent to which one's self-worth is contingent on others' appraisals. NFA involves both approach-oriented (the need to obtain positive judgments that enhance self-worth; approach NFA) and avoidance-oriented (the need to avoid negative judgments that diminish self-worth; avoidance NFA) tendencies (Rudolph et al., 2005). During development, children form the basis for their self-concept by integrating perceived and actual appraisals of significant others into their self-worth. Gradually, the sense of self stabilizes, and children who follow a normative developmental trajectory generally show declines in NFA over time, particularly as they near adolescence (Harter, 1998; Xu et al., 2022). For others, self-worth continues to rely on others' appraisals, resulting in an unstable sense of self that is dependent on environmental input. For these individuals, high NFA constitutes a source of risk during adolescence as it may bias information processing systems to be hypervigilant to social cues that imply acceptance or rejection.

Although no studies to date have examined the social-cognitive processes involved in approval-based

self-worth, research on the role of self-esteem during social information processing suggests that individuals with low self-esteem (those who perceive their self-worth contingencies to be unsatisfied) show a response bias to social cues relative to individuals with high self-esteem. For instance, relative to adolescents with high self-esteem, those with low self-esteem are more likely to attend to the gaze direction of a non-target face, an attentional bias that slows RTs to target stimuli (i.e., gaze-triggered orienting; Wilkowski et al., 2009). Individuals with low self-esteem also show a bias toward social threat, as evidenced by faster processing of exclusion-related target words when primed with rejection words (Koch, 2002). Moreover, adolescents who base their self-worth on peer approval are judged by their teachers to be significantly more distracted by peers while completing assignments in the classroom than adolescents who do not base their self-worth on peer approval (Harter et al., 1996), suggesting that these adolescents find it harder to attend to cognitive tasks in the face of social distractions.

In these studies of self-worth, the allocation of resources toward social information interferes with cognitive processing. Because youth with high approach NFA endeavor to gain social rewards in the form of positive appraisals from peers and youth with high avoidance NFA strive to avoid social punishment or the threat of punishment, we hypothesized that specific NFA orientations (approach vs. avoidance) would prompt sensitivity to a particular class of social cues (appetitive vs. aversive). The desire for social rewards may lead youth with high approach NFA to be especially sensitive to socially appetitive cues, whereas the desire to avoid social punishments may lead youth with high avoidance NFA to be especially sensitive to socially aversive cues. This sensitivity to distracting social cues may take resources away from effective engagement in cognitively demanding tasks.

Individual differences in social sensitivity: Antisocial behavior

Theories of adolescent development suggest that individual differences in social sensitivity, in concert with poor regulation, may help explain increases in risk-taking and ASB during this time (Somerville et al., 2011; Steinberg, 2008). ASB, or actions that violate social norms (e.g., irritability and aggression towards others, destruction of property, deceitfulness; American Psychiatric Association, 2000; Byrd et al., 2014) may be particularly relevant to individual differences in sensitivity to social cues given that abnormalities in reward and punishment processing have historically been conceptualized as a causal mechanism for these behaviors. Specifically, youth who engage in ASB show a propensity to engage in reward-seeking behavior, which may occur as a consequence of an overactive behavioral activation system (BAS; a motivational system that serves to increase goal-directed activity in the context of appetitive or rewarding stimuli; Gray, 1981, 1987). Moreover, youth who engage in ASB may have an underactive behavioral inhibition system (BIS; motivational system that functions to inhibit behavior in the context of aversive stimuli; Byrd et al., 2014; Gray, 1981, 1987), as reflected in an insensitivity to cues of punishment (Fowles, 1980). Importantly, both the BAS and the BIS serve to direct attentional resources toward relevant environmental stimuli that motivate behavioral responses. Thus, the presence of rewards may be a strong motivational factor to increase approach and reward-seeking behavior in antisocial youth (reflecting higher BAS), but these youth may fail to respond to cues of punishment (reflecting lower BIS; Lykken, 1995; Quay, 1993).

Supporting these theories, compared to adolescents who engage in low levels of ASB, adolescents who engage in high levels of ASB consistently display more reward-seeking behavior, even in the face of punishment (Fairchild et al., 2008; Schutter et al., 2011). Studies also have found that ASB is negatively associated with the ability to recognize sad and fearful faces (Blair & Coles, 2000) and reduced orienting to images of others' distress (Kimonis et al., 2006). Fewer studies have examined how cues reflecting *social* reward and punishment may influence youth who engage in ASB, an oversight given that peers play a large role in shaping the development of ASB. For instance, engagement in ASB is more likely to occur in groups (Warr, 2002), and is associated with the attainment of higher status among peers (Hawley, 1999). However, the contribution of ASB to adolescents' engagement in cognitive tasks in the context of socially appetitive and aversive cues is less studied (for one exception, see Perino et al., 2019). Based on theory and prior research examining reward and punishment processing in adolescents with ASB, adolescents who engage in ASB may be more sensitive to socially appetitive cues, but less sensitive to socially aversive cues. This sensitivity (or lack thereof) to social cues may have consequences for cognitive control, such that ASB may result in more cognitive interference in the context of task-irrelevant socially appetitive cues, but less cognitive interference in the context of task-irrelevant socially aversive cues.

Age and gender differences in social sensitivity

Given significant developmental changes in cognitive control (Luna, 2009) and social sensitivity (Somerville, 2013) during adolescence, this study also considered age differences in sensitivity to social cues. One study examining adolescent-specific age differences in the interfering nature of socioemotional stimuli (Cohen-Gilbert & Thomas, 2013) indicated disruptions

in cognitive control among adolescents aged 13–14 years and 15–16 years in the context of negative relative to scrambled cues, but only the younger adolescents displayed disruptions in the context of negative relative to positive cues (Cohen-Gilbert & Thomas, 2013). To take into account possible age-related differences in cognitive control in the context of socioemotional cues, we examined whether individual differences (i.e., NFA, ASB) predicted performance beyond differences in age and the interaction of age with cue type (appetitive, aversive, or neutral).

Although research on gender differences in sensitivity to socially appetitive and socially aversive cues is limited, prior studies suggest that girls may be more sensitive to appetitive and aversive images relative to boys, as reflected in higher affect ratings for both image types and greater physiological reactivity to aversive images (McManis et al., 2001). Moreover, compared to adolescent boys, adolescent girls place higher value on socially rewarding goals, such as having and maintaining friendships (Rose & Rudolph, 2006). They also have more socio-evaluative concerns (Rose & Rudolph, 2006), perceive social aggression as more hurtful, and report social aggression as a more frequent occurrence in their friend groups (Galen & Underwood, 1997), suggesting they may be more sensitive to social threat. Particularly relevant to this study, mid-adolescent girls exhibit worse cognitive control in the context of aversive stimuli relative to adolescent boys (Cohen-Gilbert & Thomas, 2013). In light of this heightened sensitivity to social cues in mid-adolescent girls, the present study focused on this group.

Study overview

We used a multi-method design to build on existing research (e.g., Cohen-Gilbert & Thomas, 2013; Dreyfuss et al., 2014; Kwon et al., 2019; Somerville et al., 2011) by testing whether the effects of socioemotional cues on cognitive control are moderated by individual differences in NFA and ASB, beyond the effects of age. Participants completed questionnaires assessing NFA and ASB as well as a modified version of a socioemotional Go/No-go task (Cohen-Gilbert & Thomas, 2013; Perino et al., 2016). During the task, participants were instructed to respond as quickly as possible to target stimuli, but to withhold responses to non-target stimuli. The stimuli were superimposed on socially appetitive (images of social acceptance and group cohesion), socially aversive (images of social exclusion or alienation), or control (scrambled) images; the socially appetitive and socially aversive images thus served as task-irrelevant socioemotional distractors. Cognitive control in the face of social cues was operationalized as performance on trials with socioemotional images compared to control trials. To examine the effect of cue valence, we also compared performance on trials with socially appetitive images relative to trials with socially aversive images. Cognitive control interference was indexed by less success (accuracy) and slower RT in one condition relative to another (appetitive vs. aversive vs. control).

Success was quantified as the likelihood of correctly responding to both "go" trials (reflecting action selection, or the ability to correctly execute responses) and "no-go" trials (reflecting inhibitory control, or the ability to correctly withhold responses). RT to "go" trials (correct hits) reflects a form of interference control due to the conflicting presentation between the socioemotional (task-irrelevant) images and the target and non-target (task-relevant) stimuli. Thus, RT was used to measure how well participants ignored the distractor images that may slow their response to the target stimuli, an effect commonly used to measure performance on the emotional Stroop task (Nigg, 2000).

Building on prior research that examined adolescent sensitivity to socioemotional cues, we tested the following hypotheses: (1) disruptions in cognitive control in the face of socially appetitive images, relative to control and socially aversive images, would be augmented in girls with high relative to low approach NFA; (2) disruptions in cognitive control in the face of socially aversive images, relative to control and socially appetitive images, would be augmented in girls with high relative to low avoidance NFA; (3) disruptions in cognitive control in the face of socially appetitive images, relative to control and socially aversive images, would be augmented in girls who engage in more than less ASB; and (4) disruptions in cognitive control in the face of socially aversive images, relative to control images would be attenuated in girls who engage in more than less ASB. For all hypotheses, we adjusted for age-related differences in cognitive control in the context of socioemotional cues.

METHOD

Participants

Participants included 88 English-speaking mid-adolescent girls (M_{age} = 16.31 years, SD = 0.84, age range = 14.9–17.7; 65.9% White, 22.7% African American, 6.8% Multi-racial, 3.4% Latinx, 1.1% Asian) from a range of economic backgrounds (27.3% income \$0–\$29,000, 23.8% income \$30,000–\$59,000, and 48.9% income above \$60,000) recruited through several small urban and rural school districts in the Midwest. During the summer following 9th, 10th, or 11th grade, a total of 90 mid-adolescent girls participated in a laboratory visit during which they completed the socioemotional Go/No-go task. Of the 90 participants, one was excluded because their responses on the task were not recorded, and another was excluded for being identified as a multivariate outlier using the Mahalanobis

distance test. Parents provided written consent and adolescents provided written assent in accordance with the Institutional Review Board. Participants received a monetary compensation for their involvement in the study.

Forty participants were recruited from a larger, longitudinal study that followed the girls from 2nd to 9th grade (for more details, see Rudolph et al., 2014) and 50 participants were recruited from a concurrent study of 9th and 10th graders. Of the 207 girls contacted, 43 were ineligible due to MRI contraindications (relevant to another part of the study), 44 declined to participate, and 30 were contacted but not scheduled before the target sample was reached. Data were collected between 2015 and 2016.

Measures

Need for approval

Participants completed the Need for Approval Questionnaire (Rudolph et al., 2005), an eight-item measure designed to assess the approach and avoidance dimensions of NFA (Rudolph & Bohn, 2014; Rudolph et al., 2005). The approach NFA dimension measures the extent to which improvements in self-worth are contingent on peer approval and acceptance (four items; e.g., "Being liked by other kids makes me feel better about myself."). The avoidance NFA dimension measures the extent to which declines in self-worth are contingent on peer disapproval and rejection (four items, e.g., "I feel like a bad person when other kids don't like me."). Participants rated how true each item was using a 5-point scale (1 = not at all to 5 = very much). Prior research has established convergent and discriminant validity for this measure (Rudolph et al., 2005). Scores were computed by taking the mean of the items on each subscale (approach NFA: $M = 2.92$, SD = 0.97, $\alpha = .91$; avoidance NFA: $M = 1.81$, SD = 0.89, $\alpha = .92$) and regressing each mean score onto the other to obtain the standardized residual. Using the residual score for our analyses allowed us to capture the unique effects of each NFA dimension.

Antisocial behavior

Participants completed a 13-item ASB questionnaire adapted from Nolen-Hoeksema and colleagues (Nolen-Hoeksema et al., 2007). Using a 5-point scale (1 = never to 5 = always), participants indicated how often they engaged in ASBs in the last few months (e.g., "I threatened to hurt people," "I stole things."). Scores were calculated as the standardized mean of the items, with higher scores indicating greater engagement in ASB ($M = 1.45$, SD = 0.46, $\alpha = .89$). Prior research has established strong reliability and convergent validity (Nolen-Hoeksema et al., 2007).

Socioemotional Go/No-go

Participants completed a Go/No-go task that was modified to incorporate salient socioemotional distractor images (Cohen-Gilbert & Thomas, 2013; Perino et al., 2016). Participants were first presented with a socially appetitive (e.g., acceptance, celebration; Figure 1a), socially aversive (e.g., victimization, bullying; Figure 1b), or control image (i.e., scrambled versions of the appetitive and aversive images; Figure 1c). In a separate undergraduate sample (Perino et al., 2016), images for the socially appetitive and socially aversive conditions were rated for emotional valence using a 9-point scale (1 = unhappy to 9 = happy), with 5 indicating a neutral response. Supporting the proposed appetitive and aversive nature of the stimuli: (1) the ratings differed significantly between the socially appetitive and socially aversive images ($t(34) = 24.56$, $p < 0.001$); (2) the socioemotional images were significantly different from neutral (social acceptance: $t(34) = 22.41$, $p < 0.001$; social rejection: $t(34) = 20.02$, $p < 0.001$); and (3) the adjusted mean ratings (distance from neutral) for the socially appetitive and socially aversive images were similar (socially appetitive: $M = 2.37$, SD = 1.26; socially aversive: $M = -2.38$, SD = 1.24; for more details, see Perino et al., 2016). The original version included some images of children and adults, which we replaced with images of adolescents to improve the saliency of these images for our sample. In addition, socially aversive images that had notably fewer visual features (i.e., contained fewer people) than the socially appetitive images were replaced to make the conditions more comparable. For the control condition, half of the socially appetitive and socially aversive images were scrambled to create equivalent, visually complex images that did not contain any discernible information.

Each image was presented on its own for 300 ms, and then a letter was superimposed on the image for 500 ms (see Figure 1d). Participants were instructed to respond as quickly as possible by pressing a button with their dominant index finger for all letters ("go" trials), except for X ("no-go" trials). The "go" trials occurred on 68% of the trials and the "no-go" trials occurred on 32% of the trials, creating a prepotent tendency to "go." The task was organized into 12 blocks, and blocks were organized by condition. Participants completed four blocks of each condition (socially appetitive, socially aversive, and control; see Table S1 for the mean and SD of scores by condition). Each block had 25 trials, for a total of 100 trials per condition, allowing for comparisons across condition type. Block presentation order was randomized for each participant. Participants were given 500 ms to respond per

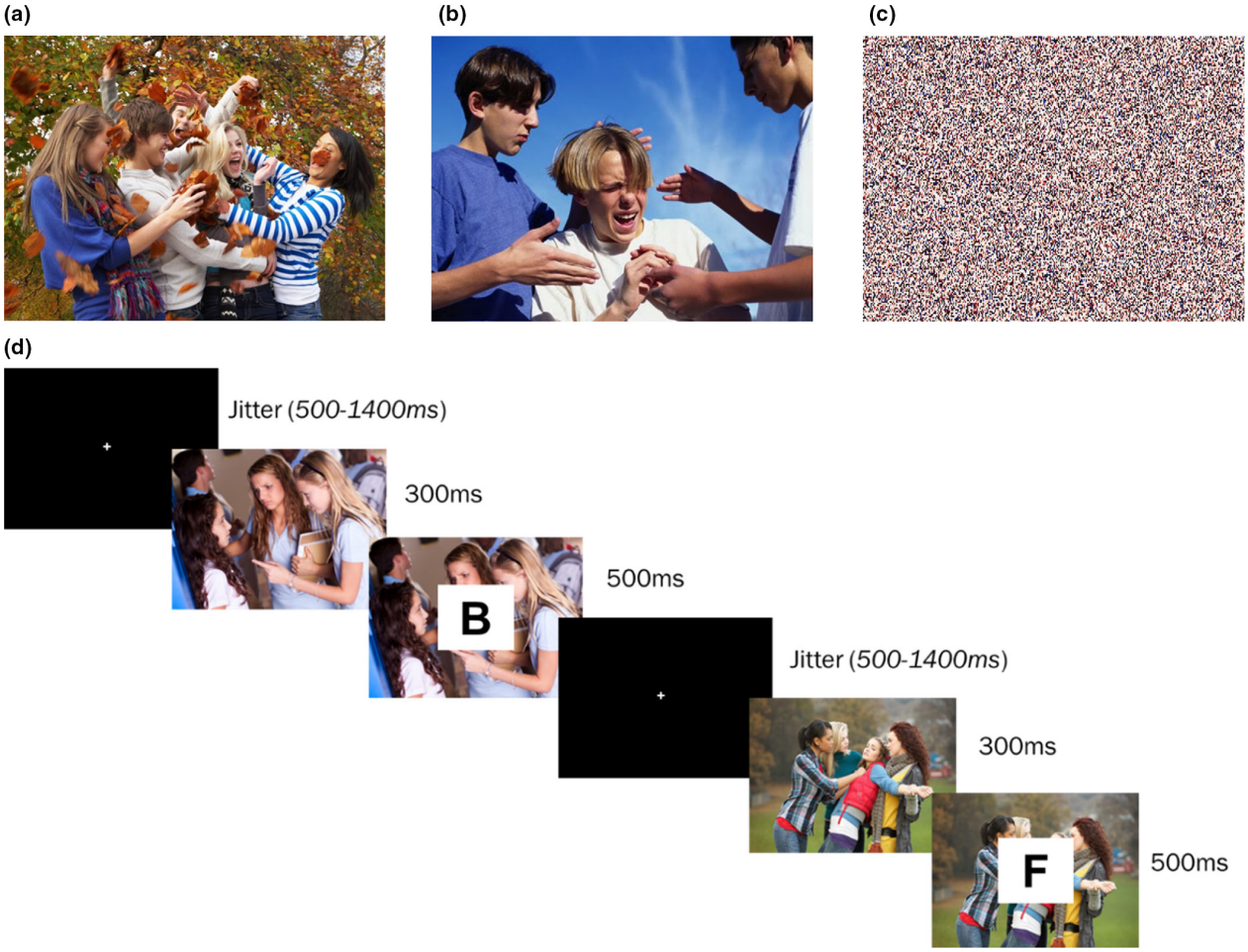

FIGURE 1 Sample cues from the (a) socially appetitive condition, (b) socially aversive condition, and (c) control condition; and (d) sample of stimulus presentation and timing

trial, with a jittered intertrial interval between 500 and 1400 ms.

Overview of analyses

Using HLM 8 (Raudenbush et al., 2019), we examined scores at the trial level by estimating separate multilevel models for each of the two performance outcomes: likelihood of success and RT. In all models, we adjusted for age by including age as a Level-2 predictor as well as a Condition × Age cross-level interaction. To test whether the moderating effect of the individual differences predicted performance beyond the effects of age and Condition × Age, we entered approach NFA, avoidance NFA, and ASB as Level 2 predictors, and their respective cross-level interactions with condition. For all significant interactions, we corrected for multiple comparisons using an approach that accounted for the correlation between the two performance outcomes ($r = -.37$, $p < .001$; the D/AP Procedure; Sankoh et al., 1997).

To place our findings in the context of previous research, we first examined whether socioemotional cues, relative to neutral cues, were associated with disruptions in cognitive control, and whether these effects depended on age (for details on this model and results, see Supporting Information). For the individual difference models, because we were interested in examining three different contrasts (socially appetitive vs. control, socially appetitive vs. socially aversive, socially aversive vs. control), we assigned two different reference groups. We opted to alternate socially appetitive and socially aversive conditions (rather than the control condition) as the reference group, as they corresponded with our specific hypotheses. To compare trials with socially appetitive cues to trials with control and socially aversive cues (Hypothesis 1 and 3), conditions were modeled as β_{2j} (1 = control, 0 = not control) and β_{3j} (1 = aversive, 0 = not aversive), with the appetitive condition serving as the reference group. To compare trials with socially aversive cues to trials with control and socially appetitive cues (Hypothesis 2 and 4), models were estimated with the socially aversive condition serving as the reference group (β_{2j}, 1 = control, 0 = not control; β_{3j}, 1 = appetitive, 0 = not appetitive).

Logistic regression was used for models estimating likelihood of success, and trial type was included as

a covariate. Accordingly, success (correct response: 1 = correct "go" or "correct no-go," 0 = incorrect "go" or incorrect "no-go") on a particular trial (i) for a particular subject (j) was modeled as a function of the overall likelihood of a correct response (β_{0j}), controlling for trial type (β_{1j}; 1 = "go" trial, 0 = "no-go" trial). All the variables were modeled as random effects, except for trial type, which was modeled as a fixed effect. For the models estimating RT to "go" trials, model set-up was identical with the exception that (1) a linear function was used to estimate the model, and (2) trial type was not included as a covariate, as only RT to "go" trials was examined. All variables were modeled as random effects (see Supporting Information for examples of the equations used to test hypotheses in the multilevel models).

Following model estimation, significant interactions were decomposed by conducting simple slope analyses at low (−1 SD), moderate (mean), and high (+1 SD) levels of the individual difference variables (Aiken & West, 1991) and results were depicted graphically. We also calculated (a) the Regions of Significance (RoS) with respect to the moderator (the values of NFA, ASB, or age for which there was a significant difference in likelihood of success or RT between conditions); and (b) effect sizes. To determine effect sizes for the logistic regression models, we used odds ratios. For models estimating RT, we calculated the proportion of variability of the slope of condition on RT that is explained by the individual difference variable (explanatory power; Aguinis et al., 2013) and the proportion of variability of the overall model that is explained by the cross-level interaction (R^2; Snijders & Bosker, 1999), which can be transformed into f^2 (Cohen, 1992).

RESULTS

Preliminary analyses

We examined bivariate associations among raw scores on the individual difference variables and between these variables and demographic variables. Approach and avoidance NFA were significantly correlated (r = .55, p<.001); neither approach NFA (r = .07, p = .54) nor avoidance NFA (r = .15, p = .16) was significantly correlated with ASB. Girls who self-identified as White (N = 58) did not significantly differ in levels of approach NFA (t = −1.93, p = .06), avoidance NFA (t = .284, p = .78), or ASB (t = 1.90, p = .07) from girls who identified as African American, Muti-racial, Latinx, or Asian (N = 30). Income status did not significantly correlate with approach NFA (r = .07, p = .51), avoidance NFA (r = −.01, p = .96), or ASB (r = −.09, p = .41). Age was marginally significantly correlated with approach NFA (r = .21, p = .05), but not avoidance NFA (r = .07, p = .49) or ASB (r = −.04, p = .72). Table S2 presents bivariate associations between the individual difference variables and mean levels of the performance variables. Table S3 presents model fit comparisons between the main effects (Level-1 Model) and the moderation by individual differences (Level-2 Model) models.

Moderation by individual differences

To test our four hypotheses, we examined whether individual differences moderated the effects of condition on performance outcomes, after adjusting for age. More detailed results of the statistical tests are included in Tables S5–S7.

Approach NFA as the moderator (Hypothesis 1)

Estimating success

To test the moderating role of approach NFA on success, we estimated the effect of the cross-level Condition × Approach NFA interaction on likelihood of success, with the socially appetitive condition serving as the reference group. As shown in Table 1, there was a nonsignificant Control × Approach NFA interaction and a nonsignificant Socially Aversive × Approach NFA interaction.

Estimating RT

To test the moderating role of approach NFA on RT, we estimated the effect of the cross-level Condition × Approach NFA interaction on RT, with the socially appetitive condition serving as the reference group. As shown in Table 2, there were significant Control × Approach NFA and Socially Aversive × Approach NFA interactions, and both remained significant after correcting for multiple comparisons (Control × Approach NFA: p = .008; Socially Aversive × Approach NFA: p = .038).

Decomposition of the significant Control × Approach NFA interaction revealed that girls had significantly slower RTs during the socially appetitive relative to the control condition at high (b = −8.80, 95% CI [−13.44, −4.17], p<.001) and average (b = −3.97, 95% CI [−7.41, −0.55], p = .02), but not low (b = 0.85, 95% CI [−4.13, 5.82], p = .74), levels of approach NFA (see Figure 2; center and right panels). The lower-bound and upper-bound RoS were −3.26 (0 cases) and −0.10 (47 cases), respectively. This suggests that responses were slower during the socially appetitive than the control condition for girls whose approach NFA was slightly below average or higher. The Control × Approach NFA cross-level interaction explained 12.09% of the variance of the effect of control images on RT, and the effect size for the cross-level interaction was small (d = .12).

Decomposition of the significant Socially Aversive × Approach NFA interaction revealed that girls had significantly slower RTs during the socially

TABLE 1 Multilevel models estimating likelihood of success, moderated by individual differences

	OR (95% CI)		
Fixed effects	**ID: approach NFA**	**ID: avoidance NFA**	**ID: ASB**
Appetitive reference group			
Intercept	4.53 (3.86, 5.32)**	—	4.54 (3.86, 5.32)**
Age	1.08 (0.95, 1.25)		1.07 (0.92, 1.23)
Individual differences (ID)	0.89 (0.77, 1.02)	—	1.06 (0.94, 1.20)
Trial Type (1 = 'go', 0 = 'no-go')	1.60 (1.26, 2.02)**	—	1.60 (1.26, 2.02)**
Control	1.02 (0.92, 1.13)	—	1.02 (0.92, 1.13)
Control × age	1.07 (0.97, 1.18)		1.08 (0.98, 1.19)
Control × ID	1.03 (0.93, 1.14)	—	1.03 (0.94, 1.12)
Aversive	1.02 (0.95, 1.12)	—	1.03 (0.95, 1.12)
Aversive × age	0.94 (0.87, 1.02)		0.94 (0.87, 1.02)
Aversive × ID	0.98 (0.90, 1.06)	—	**1.08 (1.002, 1.16)***
Aversive reference group			
Intercept	—	4.66 (4.00, 5.44)**	4.67 (4.01, 5.43)**
Age		0.99 (0.88, 1.13)	1.00 (0.89, 1.13)
ID	—	1.09 (0.96, 1.25)	1.14 (1.03, 1.26)*
Trial type (1 = 'go', 0 = 'no-go')	—	1.60 (1.26, 2.02)**	1.60 (1.26, 2.02)**
Control	—	0.99 (0.91, 1.09)	0.99 (0.91, 1.09)
Control × age		**1.15 (1.05, 1.26)****	**1.15 (1.05, 1.26)****
Control × ID	—	1.00 (0.91, 1.11)	0.96 (0.88, 1.04)
Appetitive	—	0.97 (0.90, 1.06)	0.97 (0.90, 1.05)
Appetitive × age		1.07 (0.98, 1.16)	1.07 (0.98, 1.16)
Appetitive × ID	—	0.94 (0.87, 1.02)	**0.93 (0.87, 0.998)***

Bold values represent significant interactions.
Abbreviations: ASB, antisocial behaviors; NFA, need for approval.
*$p < .05$; **$p < .01$.

appetitive relative to the socially aversive condition at high ($b = -5.58$, 95% CI [−9.99, −1.16], $p = .01$), but not average ($b = -1.83$, 95% CI [−5.02, 1.37], $p = .26$) or low ($b = 1.92$, 95% CI [−2.90, 6.74], $p = .43$), levels of approach NFA (see Figure 2; right panel). The lower-bound and upper-bound RoS were −5.72 (0 cases) and 0.41 (29 cases), respectively. This suggests that responses were slower during the socially appetitive than the socially aversive condition for girls whose approach NFA was somewhat above average or higher. The Socially Aversive × Approach NFA cross-level interaction explained 10.05% of the variance of the effect of aversive images on RT, and the effect size for the cross-level interaction was small ($d = .09$).

Avoidance NFA as the moderator (Hypothesis 2)

Estimating success and RT

To test the moderating role of avoidance NFA on success, we estimated the effect of the cross-level Condition × Avoidance NFA interaction on likelihood of success with the socially aversive condition serving as the reference group. As shown in Table 1, there were no significant interactive effects in this model. To test the moderating role of avoidance NFA on RT, we estimated the effect of the cross-level Condition × Avoidance NFA interaction on RT with the socially aversive condition serving as the reference group. As shown in Table 2, there were no significant interactive effects in this model.

ASB as the moderator (Hypotheses 3 and 4)

Estimating success

To test the moderating role of ASB on success, we estimated the effect of the cross-level Condition × ASB interaction on likelihood of success, with the socially appetitive condition serving as the reference group. As shown in Table 1, there was a nonsignificant Control × ASB interaction and a significant Socially Aversive × ASB interaction that became marginally significant after correcting for multiple comparisons ($p = .069$). Girls had a significantly higher likelihood of success during the socially aversive condition relative to the socially appetitive condition at high (OR = 1.11, 95% CI [1.01, 1.22], $p = .03$), but not average (OR = 1.03, 95% CI [0.95, 1.12], $p = .49$) or low (OR = 0.96, 95% CI [0.85, 1.08], $p = .46$), levels of ASB (see Figure 3; right panel). The lower-bound and upper-bound

TABLE 2 Multilevel models estimating RT, moderated by individual differences

	b (95% CI)		
Fixed effects	**ID: approach NFA**	**ID: avoidance NFA**	**ID: ASB**
Appetitive reference group			
Intercept	372.54 (366.78, 378.30)**	—	372.52 (366.44, 378.60)
Age	7.61 (1.98, 13.23)*		9.45 (3.65, 15.25)
Individual differences (ID)	9.43 (2.92, 15.94)**	—	−0.12 (−8.11, 7.87)
Control	−3.98 (−7.41, −0.55)*	—	−3.96 (−7.49, −0.42)
Control × age	−0.02 (−4.32, 4.27)		−1.03 (−5.12, 3.05)
Control × ID	**−4.82 (−8.20, −1.45)****	—	−2.07 (−5.57, 1.43)
Aversive	−1.83 (−5.02, 1.37)	—	−1.79 (−4.96, 1.38)
Aversive × age	1.48 (−2.22, 5.18)		0.57 (−2.78, 3.91)
Aversive × ID	**−3.75 (−7.08, −0.41)***	—	**−4.33 (−7.56, −1.09)***
Aversive reference group			
Intercept	—	370.72 (364.97, 376.47)	370.73 (365.05, 376.41)
Age		10.12 (3.83, 16.41)	10.02 (3.92, 16.12)
ID	—	−1.69 (−7.38, 4.01)	−4.45 (−11.70, 2.81)
Control	—	−2.16 (−5.38, 1.05)	−2.17 (−5.36, 1.03)
Control × age		−1.64 (−5.04, 1.77)	−1.60 (−4.95, 1.75)
Control × ID	—	1.38 (−2.34, 5.09)	**2.25 (0.03, 4.48)**†
Appetitive	—	1.80 (−1.48, 5.09)	1.79 (−1.37, 4.96)
Appetitive × age		−0.77 (−4.47, 2.92)	−0.58 (−3.91, 2.78)
Appetitive × ID	—	−0.49 (−4.08, 3.10)	**4.33 (1.09, 7.56)***

Note: Trial type was not included as a covariate for the RT models. Bold values represent significant interactions.
Abbreviations: ASB, antisocial behaviors; NFA, need for approval; RT, reaction time to 'go' trials, measured in milliseconds.
†$p < .10$
*$p < .05$; **$p < .01$.

RoS were −35.00 (0 cases) and 0.85 (11 cases), respectively. To determine effect sizes, we compared the odds of success between the socially aversive and appetitive conditions at high (0.11 higher odds), average (0.03 higher odds), and low (0.04 lower odds) levels of ASB. The effect sizes and RoS suggest that the odds of success were 0.11 times higher for the socially aversive than the socially appetitive condition for girls whose engagement in ASB was somewhat above average or higher. To test whether ASB moderated the difference between the socially aversive and control conditions, we re-estimated the cross-level interaction with the socially aversive condition serving as the reference group. As shown in Table 1, there was a nonsignificant Control × ASB interaction.

Estimating RT

To test the moderating role of ASB on RT, we estimated the effect of the cross-level Condition × ASB interaction on RT, with the socially appetitive condition serving as the reference group. As shown in Table 2, there was a nonsignificant Control × ASB interaction and a significant Socially Aversive × ASB interaction that remained significant after correcting for multiple comparisons ($p = .013$). Girls had significantly slower RTs during the socially appetitive relative to the socially aversive condition at high ($b = -6.12$, 95% CI [−11.15, −1.09], $p = .02$), but not average ($b = -1.79$, 95% CI [−4.96, 1.38], $p = .27$) or low ($b = 2.53$, 95% CI [−1.43, 6.50], $p = .21$), levels of ASB (see Figure 4; right panel). The lower-bound and upper-bound RoS were −1.77 (0 cases) and 0.47 (16 cases), respectively. This suggests that responses were slower during the socially appetitive than the socially aversive condition for girls whose engagement in ASB was somewhat above average or higher. The Socially Aversive × ASB cross-level interaction explained 14.36% of the variance of the effect of aversive images on RT, and the effect size for the cross-level interaction was small ($d = .13$).

To test whether ASB moderated the difference between the socially aversive and control conditions, we re-estimated the cross-level interaction with the socially aversive condition serving as the reference group. As shown in Table 2, there was a marginally significant Control × ASB interaction that remained marginally significant after correcting for multiple comparisons ($p = .077$). Girls had significantly slower RTs during the socially aversive relative to the control condition at low ($b = -4.42$, 95% CI [−8.59, −0.25], $p = .04$), but not average ($b = -2.17$, 95% CI [−5.36, 1.03], $p = .18$) or high ($b = 0.01$, 95% CI [−3.50, 3.68], $p = .96$), levels of ASB (see Figure 4; left panel). The lower-bound and upper-bound RoS were −.72 (16 cases) and 52.38 (0 cases),

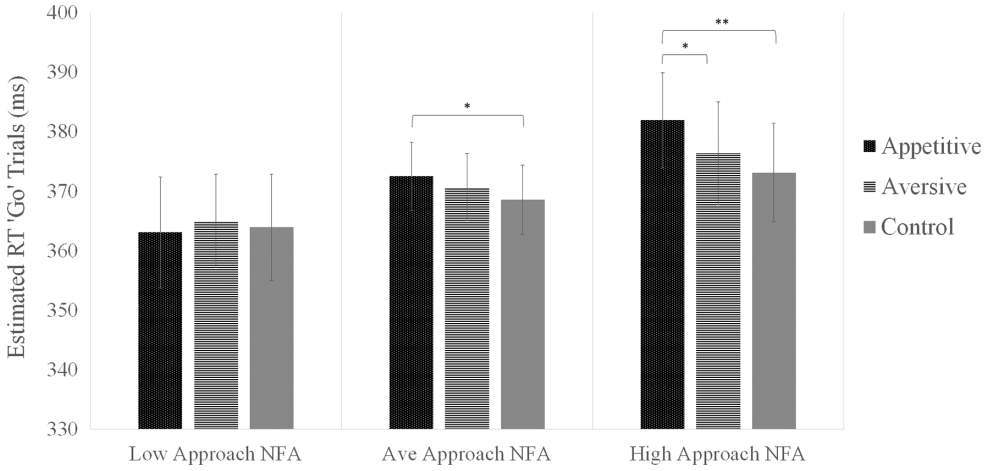

FIGURE 2 Girls showed significantly slower reaction times (RTs) during the socially appetitive than control condition when estimated at average (mean) and high (+1 SD above the mean) levels of approach need for approval (NFA). Girls also showed significantly slower RTs during the socially appetitive than socially aversive condition when estimated at high (+1 SD above the mean) levels of approach NFA. Error bars represent 95% CIs. *$p<.05$. ** $p<.01$

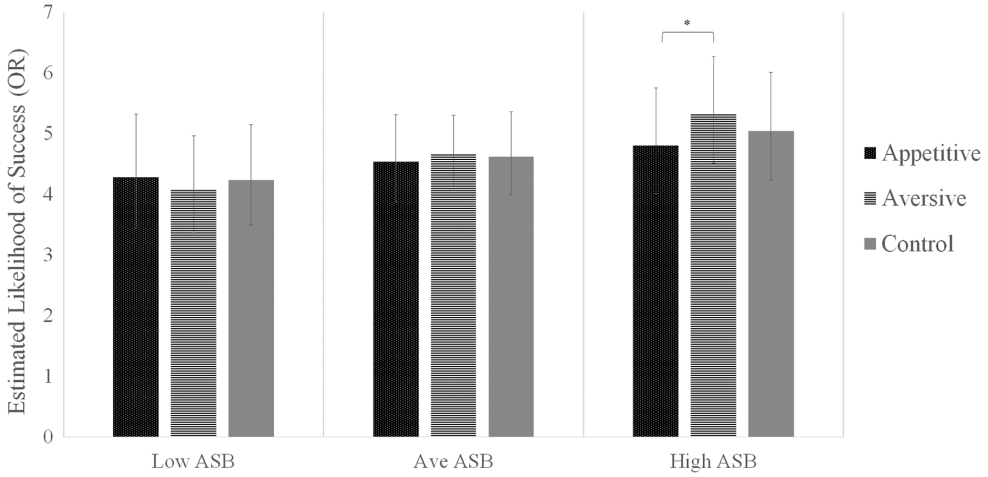

FIGURE 3 Girls showed a significantly lower likelihood of success during the socially appetitive than socially aversive condition when estimated at high (+1 SD above the mean) levels of antisocial behavior (ASB). Error bars represent 95% CIs. *$p<.05$

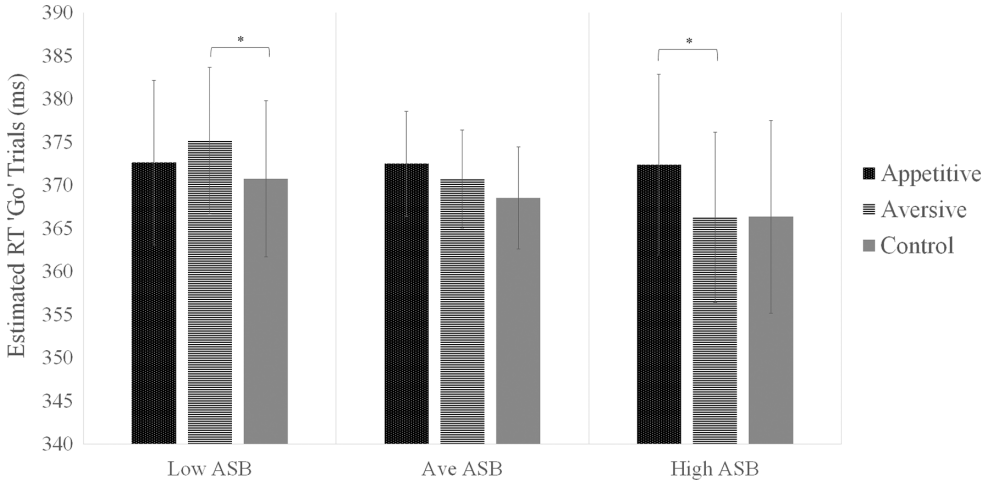

FIGURE 4 Girls showed significantly slower reaction times (RTs) during the socially aversive than control condition when estimated at low (−1 SD below the mean) levels of antisocial behavior (ASB). Girls also showed significantly slower RTs during the socially appetitive than socially aversive condition when estimated at high (+1 SD above the mean) levels of ASB. Error bars represent 95% CIs. *$p<.05$

respectively. This suggests that responses were slower during the socially aversive than the control condition for girls whose engagement in ASB was somewhat below average or lower. The Control × ASB cross-level interaction explained 0.61% of the variance of the effect of control images on RT, and the effect size for the cross-level interaction was small ($d = .005$).

DISCUSSION

Despite the significant amount of research examining developmental changes in sensitivity to social cues, few studies have investigated factors that may moderate the salience of these cues during mid-adolescence. This study addressed this gap by examining individual differences in NFA and ASB as sources of variability for disruptions in cognitive control in the face of distracting socially salient images during a Go/No-go task. Our findings indicate that individual differences (i.e., approval-based self-worth or the willingness to engage in behavior that defies social norms) have implications for disruptions in cognitive control above and beyond normative adolescent sensitivity to socioemotional cues.

Individual differences in social sensitivity

Consistent with findings from previous studies (Cohen-Gilbert & Thomas, 2013; Kwon et al., 2019; Somerville et al., 2011), we found that girls showed disruptions in cognitive control, as reflected in slower RT to "go" trials, towards socially appetitive relative to control images (see Supporting Information). However, this effect was moderated by approach NFA. Specifically, in line with our first hypothesis, we found that mid-adolescent girls high in approach NFA showed disruptions in cognitive control, as reflected in slower RTs to "go" trials, in the face of socially appetitive relative to control and aversive cues. Hence, the salience of socially appetitive cues is particularly relevant for mid-adolescent girls who tend to base their self-worth on peer approval. Because youth with high approach NFA are motivated to gain social rewards, they may be more attuned to situations that fulfill their NFA, such as engaging in positive peer interactions. These interactions afford the opportunity to foster satisfying social connections and to develop skills that provide the foundation for future social gains. Indeed, prior research indicates that children high in approach NFA show more social competence (Rudolph et al., 2005) and engage in more behaviors that elicit positive feedback from peers (Rudolph & Bohn, 2014). Thus, sensitivity to socially appetitive cues may be adaptive in certain contexts by facilitating the cultivation of relationships. However, this sensitivity to socially appetitive cues may be maladaptive in other contexts. For instance, children with high NFA have more difficulty completing assignments in the classroom as a consequence of being more distracted by their peers (Harter et al., 1996). Beyond the academic setting, increased social sensitivity may have implications for behavioral regulation, given the influence of peers and peer evaluation on risk-taking behavior (Gardner & Steinberg, 2005; Steinberg, 2008).

Contrary to our second hypothesis, mid-adolescent girls with high avoidance NFA did not show disruptions in cognitive control in the face of socially aversive relative to control or socially appetitive cues. Prior theory and research on approval-based self-appraisals suggest that youth with high avoidance NFA strive to avoid social punishment or threat of punishment as a means to prevent declines in self-worth (for a review, see Rudolph, 2021). This social threat-aversion is supported by evidence that youth with high avoidance NFA are less inclined to engage with peers (Rudolph & Bohn, 2014), perhaps for fear of risking exclusion or disapproval. We expected that the desire to avoid rejection would translate into a processing bias that works to alert youth with high avoidance NFA to instances of disapproval. However, we did not find evidence for disruptions in cognitive control in the face of socially aversive relative to control or socially appetitive cues in this study, demonstrating that mid-adolescent girls with avoidance NFA do not appear to be more sensitive to socially aversive cues than other mid-adolescents. It may be that persistent disengagement from their surroundings may condition youth with high avoidance NFA to be unaffected by socioemotional images, allowing them to perform equally well between socially salient and control conditions. Additional research is needed to understand under what conditions they would show more disrupted performance. Paradigms that require participants to fully engage with the socioemotional stimuli (Dreyfuss et al., 2014; Hare et al., 2008; Kwon et al., 2019) may provide better insight into whether or not, and to what extent, youth with high avoidance NFA are sensitive to socially aversive cues.

Interestingly, although we did not find significant main effects for the socially aversive relative to control cues on likelihood of success or RT, we did find significant interactive effects with age on success (see Supporting Information). In particular, the older adolescents in our sample (>17.14 years) were less likely to be accurate in the socially aversive condition than the control condition. Another study using a similar socioemotional Go/No-go paradigm found that 13- to 14-year-old adolescent boys and girls, as well as 15- to 16-year-old adolescent girls, made more errors on negative relative to control trials (Cohen-Gilbert & Thomas, 2013), suggesting a trend towards continued sensitivity to social cues in girls. Unexpectedly, younger adolescents in our sample (<15.45 years) were more accurate in the socially aversive compared to the control condition. It should be noted that these results should be interpreted with caution, as the age range of our sample was relatively small.

However, these findings speak to the myriad of changes that occur over small periods of development and highlight the need to employ narrower benchmarks when assessing adolescent samples. Specifically, future research should attempt to replicate these effects and consider how even minor differences in age may influence social sensitivity during cognitive control.

Consistent with our third hypothesis, mid-adolescent girls who engage in more ASB showed disruptions in cognitive control, as reflected in more cognitive control failures and slower RTs to "go" trials, in the context of socially appetitive relative to socially aversive images. This finding corresponds with theories proposing that an overactive reward system contributes to persistent engagement in ASB (Byrd et al., 2014). It should be noted that the exact opposite pattern of findings was reported in one study that administered this task to a sample of delinquent adolescents (i.e., delinquency was associated with greater disruptions in cognitive control in the face of socially aversive relative to socially appetitive images; Perino et al., 2019). Differences in findings may be attributed to variability in ASB between samples, given that our study recruited a community sample of mid-adolescent participants, whereas the aforementioned study recruited participants whose ASB resulted in institutional involvement. As suggested by Perino et al. (2019), delinquent adolescents who live in dangerous or threatening environments may be more attuned to socially aversive cues as a way to adapt and ensure survival, whereas our sample of mid-adolescents may have experienced less challenging environments. Given the relatively low levels of ASB in our sample, it may be that our findings are generalizable to community samples in which ASB does not require detention or institutionalization but still impacts well-being and social outcomes. These differences in results suggest the importance of examining the entire spectrum of symptom severity associated with ASB, as different findings may have different implications for risk and intervention.

The similarity in findings between approach NFA and ASB is unsurprising considering there are significant positive associations between contingent self-worth (i.e., self-worth based on the perceived evaluations of others) and proactive and reactive aggression (Barry et al., 2018). Importantly, individuals who are sensitive to socially appetitive cues more so than other adolescents may be particularly susceptible to peer influence, which may contribute to engagement in risky behaviors. This conceptual overlap may point to a potential additive effect of approach NFA and ASB on cognitive control, an area of exploration for future research. Although individuals with high approach NFA and those who engage in ASB may have somewhat overlapping motivational orientations, affiliation with specific peer groups may underlie differences in relationship goals (e.g., group harmony vs. dominance). Future studies should examine the circumstances under which social motivation orientations diverge into different social goals, and the role of cognitive control in regulating behavior.

Finally, consistent with our fourth hypothesis, mid-adolescent girls who engage in less ASB showed differences in performance, as reflected in slower RTs to "go" trials, in the context of socially aversive relative to control images. This finding suggests that mid-adolescent girls who engage in less ASB are more distracted by socially aversive images. This difference in sensitivity to aversive cues between those who in engage in more versus less ASB is consistent with prior theory and research on ASB and punishment insensitivity (Byrd et al., 2014; Fowles, 1980). Youth who engage in ASB and associated behaviors show impairments in recognizing fearful and sad facial expressions (Fairchild et al., 2009). Accordingly, individuals at the low end of ASB engagement may be more mindful of socially aversive cues, whereas those who engage in more ASB may be more adept at ignoring cues of social discomfort, which may help perpetuate their behavior. Whether resistance to socially aversive cues drives, or is a product of, traits associated with ASB (e.g., callousness, lack of remorse), may be a topic for future research.

Contributions and limitations

Adolescence is a high-risk period for psychopathology, a vulnerability created in part by heightened socioemotional arousal and less effective cognitive control. Despite this developmental mismatch between reactivity and regulation, not all adolescents are at increased risk for maladjustment. Many studies have attempted to elucidate individual differences in disordered patterns of thoughts and behaviors during adolescence, although fewer studies have examined them in relation to sensitivity to socially appetitive and socially aversive cues. This study provides a novel perspective by identifying characteristics associated with the increased salience of social cues during mid-adolescence. Importantly, it provides insight into one cost of this increased sensitivity (e.g., poorer cognitive control), which has implications for well-being. As we suggest, sensitivity to appetitive social cues can be associated with risky behaviors and possibly worse academic success. However, it is important to recognize that increased sensitivity to social cues also may confer benefits that are important to adolescent development, such as the development of social competence (Rudolph et al., 2005) and prosocial behavior (Rudolph & Bohn, 2014). Given that the social environment becomes increasingly complex during adolescence, heightened sensitivity to social cues may be adaptive in certain contexts. Future research should examine whether and how prevention and intervention programs can leverage this sensitivity to benefit individuals while also avoiding certain costs (e.g., diminished control).

Despite these contributions, it is important to note a few limitations of this research. Given the concurrent nature of our research design, we cannot confirm the

direction of effects between disruptions in cognitive control in the face of socioemotional images and the individual difference variables. It may well be that sensitivity to specific cues shapes motivational orientations and behaviors over the course of development. It is also likely that personal attributes predispose certain youth to attend to some cues but not others. Further research would benefit from a longitudinal design to help shed light on the direction of effects.

Although we calculated effect sizes to help aid in the interpretation of significant interactions, previous studies that administered the socioemotional Go/No-go in adolescent samples have not (Breiner et al., 2018; Cohen-Gilbert & Thomas, 2013; Cohen et al., 2016; Dreyfuss et al., 2014; Hare et al., 2008; Kwon et al., 2019; Perino et al., 2016; Rogers et al., 2020; Somerville et al., 2011), making comparisons across studies somewhat difficult. Direct comparison of RT across studies (without taking into account standard error, sample sizes, etc.) suggests that significant differences appear to be in the range of 14–42 ms (Cohen-Gilbert & Thomas, 2013; Hare et al., 2008; Tottenham et al., 2011), a difference that is slightly larger than the RT findings in this study. Importantly, previous differences in RT represent the main effects of condition or age group, and do not reflect interactive or moderation effects. Given that smaller effects are common with moderation analyses, the sizes of our effects are expected. Of note, the pattern of results was quite similar after correcting for multiple comparisons, although the Socially Aversive (relative to socially appetitive) × ASB interaction predicting the likelihood of success became marginal, and thus this effect should be interpreted with caution. It is possible that a wider distribution of ASB may have been beneficial to obtain more robust effects. Overall, these findings provide a starting point for future studies that aim to examine individual differences in adolescent sensitivity to socioemotional cues.

Another limitation to note is that we chose the labels "appetitive" and "aversive" based on affective ratings provided by a separate sample. It is possible that youth may vary in how appetitive or aversive they perceive these images, which may explain some of the variance in cognitive control. On a related note, the scrambled images in our task lacked any perceptible content, contrary to other studies that have used calm faces in their control condition (Breiner et al., 2018; Cohen et al., 2016; Dreyfuss et al., 2014; Hare et al., 2008). Given that calm facial expressions do not always reflect a lack of affect, as "calmness" can be perceived as pleasant or unpleasant depending on the individual, we opted instead to follow the lead of a previous study that use scrambled images (Cohen-Gilbert & Thomas, 2013). Using scrambled images allowed for a true control condition, devoid of any potentially interfering information or valence. However, the visually distinguishable details from the socioemotional trials relative to the control trials may have contributed to differences in performance beyond the effect of valence, and further research examining how individual differences interact with condition type using other forms of control images (e.g., buildings) is warranted.

In addition, participants in our sample completed a social feedback task prior to the socioemotional Go/No-go task during the laboratory session. The social feedback task involves receiving ostensible feedback on whether peers agree or disagree (or both, with half agreeing and half disagreeing) with the participant's personal preferences for a variety of topics. Receiving peer feedback on personal preferences may have sensitized participants to the socially appetitive and socially aversive images of the emotional Go/No-go. However, all participants received equal amounts of positive and negative feedback in the social feedback task and all completed the tasks in the same order, so we would expect a general sensitization to social stimuli rather than valence-specific effects.

The focus of our research was on mid-adolescent girls, so it is unclear whether similar effects would be observed in a sample of mid-adolescent boys, or adolescents of other age ranges. Although, in general, adolescent girls may be more socially sensitive than adolescent boys (Galen & Underwood, 1997; McManis et al., 2001; Rose & Rudolph, 2006), it is likely that certain characteristics in boys similarly predict more (or less) sensitivity to socioemotional cues. For instance, in light of the fact that social engagement is more strongly guided by approach NFA in boys than in girls (Rudolph & Bohn, 2014), our finding that mid-adolescent girls high in approach NFA are more sensitive to socially appetitive than control images may be replicated in a sample of mid-adolescent boys. Thus far, research has yet to compare potential differences in reward and punishment processing between boys and girls who engage in ASB, even though there are well-established gender differences in the prevalence and trajectories of these behaviors. Therefore, this research should be considered a first step in identifying differences in the salience of social cues in girls who engage in ASB, with future research aiming to investigate these differences in adolescent boys. Finally, although our sample is representative of the demographic characteristics of the surrounding region, it is unclear whether our results are generalizable to more diverse samples of adolescent girls. Indeed, it is important to acknowledge that some racial and ethnic groups may unique associations with socially evocative stimuli due to the development of complex social identities (e.g., overlapping group memberships), engagement with culturally specific values related to interpersonal relationships (e.g., collectivism), or experiences with discrimination. Future research should consider testing adolescent social sensitivity in more diverse samples to explore the effects of race and ethnicity.

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ORCID

Haina H. Modi https://orcid.org/0000-0003-2440-6227
Wendy Troop Gordon https://orcid.org/0000-0003-4744-9385
Eva H. Telzer https://orcid.org/0000-0002-2351-6339
Karen D. Rudolph https://orcid.org/0000-0002-6190-3356

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