A Computerized Task for Investigating the Relation Between Attentional and Emotional Processes in Children

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ABSTRACT. The authors’ goals in this article are to (a) describe a new task for the assessment of shifting attention between different affective stimuli, The Children’s Attentional Shifting Task (CAST); (b) present the theoretical background for the development of the CAST; and (c) report initial information on the developmental appropriateness and validity of the CAST. The task was tested using a sample of kindergarten and 1st-grade children, 50% of whom had social and conduct problems. Preliminary analyses showed that the CAST was not subject to problems arising from fatigue or loss of interest. Moreover, children’s ability to shift attention away from angry facial expressions was positively related to teachers’ ratings of their ability to shift attention and parents’ reports of children’s emotion regulation. Shifting away from negative affect also predicted children’s academic performance as reported by teachers.

Keywords: academic performance, attention, computer task, emotion regulation

COGNITIVE PROCESSES INFLUENCE and are influenced by emotional processes (Blaney, 1986; Deldin, Keller, Gergen, & Miller, 2001; Fox, Russo, Bowles, & Dutton, 2001; Mathews, 1990; Tucker & Derryberry, 1992; Wilkelman & Cacioppo, 2001; Wilson & Gottman, 1996; Zajonc, 1980). Neuroscience researchers also have identified numerous interactions between subcortical motivational processes such as emotion and cognitive processes in the cortex (LeDoux, 1987; Saper, 1987). One cognitive process that has proven useful for investigating the relation between cognition and emotion involves shifts in attentional focus.

The investigation of attentional shifting may be important for understanding relations between cognitive and emotional processes for several reasons. First,
the orienting of attention determines which of numerous channels of available information will be brought to higher levels of cognitive processing. The direction of attentional focus also is influenced by emotional arousal. Emotional states tend to direct one’s attention toward information that is relevant to that state (Derryberry & Tucker, 1994). For example, anxious individuals show attentional biases toward potential threats or danger (Fox et al., 2001; MacLeod, Mathews, & Tata, 1986).

Second, shifting attention is associated with the regulation of emotional arousal. Shifting attention toward a positive stimulus tends to elicit or enhance positive emotions, whereas shifting attention away from a negative stimulus tends to attenuate negative affect (Derryberry & Rothbart, 1988) and decrease physiological arousal (Rothbart & Derryberry, 1981). There is evidence that these processes remain important during different stages of development. For example, temperamental measures of the ability to control attention (i.e., the ability to focus and shift attention) are related to relatively low levels of negative affect in infants (Rothbart, Ziie, & O’Boyle, 1992), children (Eisenberg, Fabes, Nyman, Bernzweig, & Pinuelas, 1994), and adults (Derryberry & Rothbart). Several researchers also found that an inability to disengage attention during laboratory tasks was related to greater negative affect in infants (Johnson, Posner, & Rothbart, 1991; Rothbart et al., 1992) and adults (Compton, 2000).

These studies suggest that the investigation of attentional orienting in emotion-eliciting situations may provide important insights into basic mechanisms that guide cognition and behavior across development (Derryberry & Tucker, 1991, 1994; Posner, 1988). In addition, a better understanding of these processes may facilitate the development of more effective prevention and intervention programs for many behavioral and emotional problems in children, adolescents, and adults. For example, one theory of depression is that it involves a general inability to disengage from negative affect (Posner & Rothbart, 1998), and anxiety in adults is related to difficulties in shifting attention away from threatening events (Derryberry & Tucker, 1994). Particularly relevant to the current study, aggressive and peer-rejected children tend to focus on environmental cues related to hostility and
anger, especially in provocative peer settings, and have difficulty shifting attention away from these cues (Dodge, 1980; Dodge & Somberg, 1987; Gouze, 1987). A better understanding of the relations between emotion and cognition may also lead to the development of better interventions for improving children’s academic competence. Recently, researchers have found links between effective attention skills and better academic achievement in children (National Institute of Child Health and Human Development Early Child Care Research Network, NICHD ECCRN, 2003; Wilson, 2003). Previous research with the current sample found a significant relation between children’s ability to shift attention between different facial expressions of emotion and their reading achievement (Wilson).

The current article presents information on the development and validity of a task that assesses children’s ability to shift attention between different affective stimuli. The Children’s Attentional Shifting Task (CAST) was designed as a downward extension of tasks used to investigate relations between attentional and motivational systems in adults (Derryberry, 1993). Adult tasks are not appropriate for use with young children because they typically require hundreds of trials and involve stimuli that are not intrinsically interesting to children. To make the task more interesting to children and to control for individual differences in reading skills, the CAST uses photographs of children making emotional facial expressions instead of emotion words (Camras, 1987). The development of appropriate tasks for young children is necessary for understanding how attentional and emotional processes influence child development and to facilitate comparisons with adult findings in this area of research.

Wilson (2003) recently reported on the utility of the CAST for assessing attentional and emotional processes in an at-risk sample of children. She found that early grade school children with social and conduct problems (i.e., aggressive/rejected children) had difficulty shifting attention away from angry facial expressions but not from happy or neutral facial expressions. Comparison children without conduct or social problems did not have difficulty shifting attention between happy, angry, or neutral facial expressions. Information gathered with the CAST also proved useful for understanding the social behaviors of the at-risk and comparison children. Children’s ability to shift attention between different emotional facial expressions on the CAST explained significant variance in their latency to share with peers who had previously ignored their social bids. Children who were better able to shift attention between emotional faces had shorter latencies for sharing. This was true even after controlling for children’s social status/aggressiveness with peers and their ability to regulate negative behavior during the social task.

In the present study, we investigated the developmental appropriateness of the CAST for early grade school children. In particular, we investigated whether the time available for inspection of the stimuli was sufficient for young children to process the visual display and complete a behavioral response during CAST trials. We also evaluated children’s engagement with the task by examining their
hit rates and reaction times across trials of the CAST. Stability in hit rates and stability or decreases in reaction time over trials should prove to be good indicators of children’s interest in the task and whether they become fatigued during the course of completing the task.

We also investigated information on the validity of the CAST. In these analyses, we focused on CAST trials that required children to shift attention away from angry to happy facial expressions because disengagement from negative affect appears to be more difficult than disengagement from positive affect (Coie & Dodge, 1988; Derryberry & Tucker, 1994). Previous research with the current sample found that aggressive/rejected children had more difficulty shifting attention away from negative affect than nonaggressive/popular children did (Wilson, 2003). Further, it may be that difficulty disengaging from negative affect interferes with children’s peer interactions and academic performance (Rothbart, Ahadi, & Hershey, 1994).

We reasoned that children’s ability to shift attention away from negative affect should be more strongly related to parents’ temperamental ratings of children’s ability to shift attention than to parents’ ratings of children’s ability to focus attention. In addition to relating our measure of attention shifting to other measures of these skills, we also investigated the validity of the CAST by relating it to two concurrent measures of emotion regulation. Previous research and theory suggest that the ability to shift attention away from negative events is related to emotion regulation skills (Compton, 2000; Derryberry & Rothbart, 1988; Derryberry & Tucker, 1994; Eisenberg et al., 1994; Johnson et al., 1991; Rothbart & Derryberry, 1981; Rothbart et al., 1992). Unfortunately, most researchers have estimated attention shifting through temperamental measures that are subject to reporter biases (Bates, 1980). Previous research with the current sample found that performance on the CAST predicted children’s tendency to share with peers who had previously ignored their social requests (Wilson, 2003). Sharing after social failure was conceptualized as evidence of children’s effective regulation of negative emotion. In the current study, we expand on this previous research by examining the relation between attention shifting and parents’ report of emotion regulation. Finally, because previous research indicates that attention skills are related to aspects of children’s academic achievement (NICHD ECCRN, 2003; Wilson, 2003), we expected that attention shifting would predict academic achievement.

Method

Participants

Fifty-four kindergarten and first-grade children participated in this research. We selected children for inclusion in the study on the basis of assessments of their social and conduct problems. Children with parental consent (N = 778, consent
rate = 76%) completed individual sociometric interviews. A nomination procedure was used to determine the social status and aggressiveness of classmates (Coie & Dodge, 1988; Coie, Dodge, & Coppotelli, 1982). Children nominated three classmates whom they “like to play with the most” (positive nomination; PN) and three classmates whom they “like to play with the least” (negative nomination; NN; Alain & Begin, 1987; Dorval & Begin, 1985). Children also nominated classmates who matched the description, “fights a lot and says mean things.” Coie et al.’s (1982) criteria were used to determine children’s social status. An index of social preference (SP) was obtained by subtracting standardized NNs from PNs and restandardizing the results. Children were categorized as rejected when their SP scores were 1 or more standard deviations below their class mean. Children were considered popular when their SP scores were 1 or more standard deviations above their class mean. To be considered high in aggression, children needed to have standardized aggression scores of 0.80 SD or more above their class mean, whereas children low on aggression had standardized scores less than zero (French, 1988; Hecht, Inderbitzen, & Bukowski, 1998; Zakriski & Coie, 1996).

Families of children with extreme scores on social preference and aggressiveness were contacted about participation in the study (consent rate = 86.4%). The final sample involved 27 aggressive/rejected children (14 boys, 13 girls) and 27 nonaggressive/popular children (13 boys, 14 girls). Ethnicity of the final sample was predominately Caucasian (N = 51). Of the remaining children, two were Hispanic and one was African American.

Procedure

Children came to the laboratory for a 1.5-hr session that included assessments of their social and attentional skills. In this article we only present assessments involving children’s attention skills and several parent/teacher reports. See Wilson (2003, 2006) for information about the other tasks completed by the children in the study. The parent primarily responsible for childcare completed all parent-report measures. In all but four instances, families identified the primary parent as the child’s mother. Children completed the attention assessment on an individual basis in a sound-attenuated room.

Measures

The Children’s Attention Shifting Task (CAST)

Equipment for the CAST consists of a Micron personal computer, a standard keyboard, and two adjacent computer monitors. A small blue light, a central fixation point, is mounted at the junction between the two monitors. The program for presenting the CAST was written with MEL2 software (manufactured by
Psychology Software Tools; Schneider, 1995). Responses are made by pressing the space bar on the keyboard and are recorded automatically by the computer program.

**Stimuli.** Stimuli for the CAST are pairs of 4.75 × 6 in. black and white photographs of children making different facial expressions: happy (H), angry (A) or neutral (N). Photographs are matched by gender to participants. The photographs of different facial expressions were verified as valid representations of universally recognized facial expressions of emotion (Camras, 1987).

The pairs of facial expressions used in the CAST are displayed simultaneously, one on each computer screen. Photographs are presented approximately 8° to the left and 8° to the right of the central fixation point. At least one neutral face is present in each pair. Some pairs contain two neutral faces and serve as control pairs (i.e., no target stimulus is present). Other pairs involve a neutral and emotion face (happy or angry).

**Trials.** Figure 1 illustrates two trials from the CAST. A trial involves two consecutively displayed facial-expression pairs. For example, a trial might contain (a) an H–N pair followed by an N–A pair, (b) an A–N pair followed by an N–H pair, (c) an N–N pair followed by an H–N pair, etc. A complete list of CAST trials is presented in Table 1. Each pair of faces is displayed for 2,500 ms. The interstimulus interval is 1,000 ms. A central fixation point, the blue light, is presented between trials. Participants are instructed to press the space bar between trials when they are ready for the next trial to begin. Consequently, the intertrial interval is determined by each participant and varies from trial to trial.

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**FIGURE 1.** Two trials from the Children’s Attentional Shifting Task (CAST). A = angry face; H = happy face; N = neutral face. The first trial represents a critical trial, whereas the second trial represents a control trial.
The CAST involves a total of 40 trials (i.e., 80 emotion expression pairs). The total number of trials was limited to 40 because piloting indicated that kindergarten children become too fatigued when completing a larger number of trials. The majority of trials are devoted to two critical sequences that, respectively, require participants to shift their attention from angry to happy faces (i.e., A–N to N–H) or from happy to angry faces (i.e., N–H to A–N). Accuracy in identifying an emotion face in the second pair (i.e., after shifting attention from the first emotion face) is used as an index of the ability to shift attention from one affective stimulus to another. A higher proportion of critical to noncritical trials is used so that hypotheses about difficulties in shifting attention from different affective states can be tested. Of the 40 trials, 10 or 14 involve each of the two critical sequences. The remaining trials involve other noncritical comparison trials such as N–N to A–N, N–N to H–N, A–N to N–N, and N–H to N–N (3 or 5 instances of each type of trial were used).

Two different versions of the CAST were created by varying the location where happy and angry facial expressions are presented. In one version, happy facial expressions are consistently presented on the right monitor and angry faces on the left monitor for each trial. The second version of the task reversed this monitor-face assignment. Presentation of the two versions was counterbalanced. Both versions ensure that children must shift their attention from one monitor to another (i.e., from right to left or left to right) between the first and second pair of faces in each trial. A correct response is scored for a space bar press when an angry or happy face is displayed on either monitor. A false alarm is scored if the space bar is pressed when neutral faces are displayed on both monitors (i.e., during control pairs). Dependent variables from the CAST included children’s hit rates and reaction times for responding to the second pair of facial expressions in each trial.

**Administration of the CAST.** Administration of the CAST required children to sit approximately 13 in. (33 cm) from the two monitors. Before completing the CAST, all children received a short period of training. During this training ses-

<table>
<thead>
<tr>
<th>Trial</th>
<th>First pair</th>
<th>Second pair</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>happy–neutral</td>
<td>neutral–angry</td>
</tr>
<tr>
<td>2</td>
<td>neutral–angry</td>
<td>happy–neutral</td>
</tr>
<tr>
<td>3</td>
<td>happy–neutral</td>
<td>neutral–neutral</td>
</tr>
<tr>
<td>4</td>
<td>neutral–neutral</td>
<td>happy–neutral</td>
</tr>
<tr>
<td>5</td>
<td>neutral–angry</td>
<td>neutral–neutral</td>
</tr>
<tr>
<td>6</td>
<td>neutral–neutral</td>
<td>neutral–angry</td>
</tr>
</tbody>
</table>

*Note. CAST = Children’s Attentional Shifting Task.*
sion, children were first shown facial expressions that would be used in the task and were asked to verbally match each facial expression with the correct emotion label. During the second phase of training, they practiced pressing the space bar on the computer keyboard each time a happy or angry face appeared on either the right or left computer monitor and practiced not pressing the bar when only neutral facial expressions were displayed. They were also trained to look at the small blue light between the two monitors when it was activated between each trial and to press the space bar as soon as they were ready for the next trial to begin. In addition, children were trained to keep their hands on the space bar between trials. Children were given additional trials if they had difficulty recognizing the different facial expressions or following the rules of the task. No child required more than two training sessions. Because the intertrial interval was allowed to vary, the total time for this task varied from approximately 4 to 6 min.

While children completed the CAST, the experimenter sat quietly in a chair a short distance behind them and recorded notes about the session. Children were told by the experimenter that she could not speak to them or help them during the actual task. Although the presence of an adult during testing is not standard procedure for other assessments of attention such as the continuous performance task (CPT) during neuropsychological exams, the goals of the current study differed somewhat from these other contexts. Because the goals were to assess relations between emotional and attentional processes, we used procedures to maximize the number of CAST trials that would contain valid data. Previous research indicates that the presence of an adult during testing increases the compliance and performance of children with behavior problems (Draeger, Prior, & Sanson, 1986).

Parents’ Reports of Children’s Self Control.

The Self-Control Rating Scale (Kendall & Wilcox, 1979) is a 33-item scale concerning children’s ability to inhibit behavior and regulate attention. The scale has demonstrated good internal consistency ($\alpha = .98$).

Parents’ Reports of Children’s Emotion Regulation.

This 45-item questionnaire (Katz & Gottman, 1986) contains two subscales. The Up-Regulation subscale contains items related to encouraging an inhibited or fearful child. The Down-Regulation subscale concerns the extent to which parents need to calm their child, control temper tantrums, or restrict inappropriate behavior, and was the subscale used in the current study. The Child Regulation Index (CRI) has been used with preschool and early grade school children (Gottman, Katz, & Hooven, 1996; Wilson, Fernandes-Richards, Aarskog, Osborn, & Capetillo, in press). It has acceptable internal consistency (mean $\alpha = .74$) and correlates with a number of childhood problems (Gottman et al.; Wilson et al.).
**Teachers’ Reports of Children’s Attention Shifting and Focusing.** Teachers completed two subscales of the Child Behavior Questionnaire (CBQ; Rothbart et al., 1994). This questionnaire conceptualizes temperament as individual differences in emotional and physiological arousability and regulation. Scales used in the present study included the Attentional Focusing (N = 13 items) and Attentional Shifting (N = 13 items) scales. The CBQ subscales have adequate reliability (mean $\alpha = .87$; Eisenberg et al., 1997).

**Teachers’ Reports of Children’s Academic Performance**

Children’s academic performance was assessed by teacher reports from the Teacher Report Form (TRF; Achenbach, 1991). These reports ranged from 1 (far below grade level) to 5 (far above grade level). The Academic Performance scale of the TRF has good psychometric properties. Achenbach reported test–retest reliability of .93. Evidence for the validity of the Academic Performance subscale comes from analyses showing that when compared to the Total Adaptive and Total Problem scores, it was the single best predictor of whether or not students were referred for help with problems in their behavioral/emotional development. This was true regardless of children’s age or gender (Achenbach).

**Results**

 Responses that occurred within the first 200 ms after stimulus presentation on the CAST were counted as anticipatory responses. A separate tally was kept of these responses, and they were subtracted from the block for analyses. We presumed that these responses occurred too quickly to be based on a decision that the stimulus was the target and instead might have been related to impulsiveness. The percentage of anticipatory responses for trials involving shifts away from angry to happy facial expressions was very low, less than 1.5%. Similar procedures have been used by other researchers (e.g., O’Dougherty, Neuchterlein, & Drew, 1984; Suess, Porges, & Plude, 1994).

In the first set of analyses, we evaluated the appropriateness of the CAST for use with early school age children. To investigate whether the presentation time for stimuli on the CAST was sufficient for early grade school children to process the visual display and initiate a behavioral response, children’s overall hit rates for critical trials (i.e., trials involving shifts from happy to angry or angry to happy faces) were examined. Because the number of critical trials varied across individuals (20 vs. 28 trials), raw frequencies were converted into proportions (hits for critical trials over the total number of critical trials) for this analysis and arcsine transformed. On average, children had a 90% hit rate for critical trials on the CAST ($SD = 0.14$, range $= 0.39–1.00$).
To investigate children’s engagement with the task and whether 40 trials fatigued them, we examined hit rates and reaction times across the different blocks of trials. For each child, the 40 trials were grouped into four blocks of 10 trials each. The proportion of correct responses to the second pair of faces presented during each trial was computed for each child, for each trial block. Nonresponses to neutral faces and responses to happy or angry faces were both considered correct responses for the purposes of these analyses. A repeated measures analysis of variance (ANOVA) across the four trial blocks, with the proportion of correct responses as the dependent variable, was not significant, $F(2.58, 134.15) = 0.58$, $p = .60$, Greenhouse-Geisser correction. Children’s performance across all blocks of the trials did not differ significantly (see Figure 2).

A second repeated measures ANOVA was performed across trial blocks with reaction time as the dependent variable. Only reaction times for responses that were correct (i.e., hits) were included in these analyses. Reaction times significantly decreased in a linear manner over trial blocks, $F(2.74, 139.71) = 3.20$, $p = .03$, Greenhouse-Geisser correction, from a mean of 1,268 ms for Block 1 to a mean of 1,167 ms on Block 4 (see Figure 3). Reaction times for Block 1 were significantly different from reaction times for Blocks 3 and 4, $p$s < .05, suggesting that, with experience, children’s performance on the CAST improved over time.

![Figure 2](image-url)
Evaluation of the Validity of the CAST

Correlations between children’s ability to shift attention away from angry to happy facial expressions and variables theoretically and empirically linked to attention shifting in previous studies are presented in Table 2. As Table 2 shows, children’s ability to shift attention away from negative affect on the CAST was positively and significantly related to teachers’ reports of their ability to shift attention, whereas the relation between attentional shifting and teachers’ reports of children’s ability to focus attention was not significant. As expected, we found significant associations between shifting attention and parent report of emotion regulation and self-control. Shifting attention was also related to teachers’ reports of children’s academic performance.

Because we used an extreme groups’ design, we investigated the relative contribution of children’s status (i.e., social status and aggressiveness) and their ability to shift attention during the CAST to their emotion regulation skills and achievement. In these analyses, we evaluated the contribution of children’s status/aggressiveness in the first step of the regression before entering children’s CAST performance in the second step. We conducted separate analyses for each estimate of emotion regulation as well as academic performance. Table 3 displays the standardized regression coefficients, $R^2$, adjusted $R^2$, change in $R^2$, and semi-partial correlations ($sr^2$) for these regressions.
TABLE 2. Correlations Between Attentional Shifting and Theoretically Related Variables in Sequential Regression

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</thead>
<tbody>
<tr>
<td>1 AH acc</td>
<td>—</td>
<td>—</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>2 Status</td>
<td>.39**</td>
<td>—</td>
<td></td>
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<tr>
<td>3 CBQS-T</td>
<td>.40**</td>
<td>.55***</td>
<td>—</td>
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<tr>
<td>4 CBQF-T</td>
<td>.12</td>
<td>.43**</td>
<td>.61**</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5 DownR-P</td>
<td>−.38**</td>
<td>−.38**</td>
<td>−.29*</td>
<td>−.12</td>
<td>—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 SelfC-P</td>
<td>−.33**</td>
<td>−.32*</td>
<td>−.52**</td>
<td>−.37*</td>
<td>.44**</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>7 AcadP-T</td>
<td>.42**</td>
<td>.37**</td>
<td>.40**</td>
<td>.50***</td>
<td>−.28*</td>
<td>−.37**</td>
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</table>

Note. AH acc = ratio of accuracy for Children’s Attentional Shifting Task trials involving shifts from angry to happy facial expressions; Status = child’s social status and aggressiveness; CBQS-T = teacher’s report of child’s ability to shift attention from Child Behavior Questionnaire (CBQ); CBQF-T = teacher’s report of child’s ability to focus attention from CBQ; DownR-P = parent’s report of child’s emotion regulation from the Down Regulation subscale of Child Regulation Index; SelfC-P = parent’s report of child’s self-control; AcadP-T = teacher’s report of child’s achievement from the Teacher Report Form.

*p < .05. **p < .01. ***p < .001.

TABLE 3. Sequential Regressions Testing the Contributions of Status and Attention Shifting to Child Outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>( \beta )</th>
<th>( R^2 )</th>
<th>Adjusted ( R^2 )</th>
<th>( \Delta R^2 )</th>
<th>( sr^2 )</th>
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<td><strong>Down regulation-P</strong></td>
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<tr>
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<td>.13</td>
<td>.14**</td>
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<tr>
<td>AH acc</td>
<td>−.28</td>
<td>.21</td>
<td>.18</td>
<td>.07*</td>
<td>.07</td>
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<tr>
<td><strong>Self-control-P</strong></td>
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<td>Status</td>
<td>−.23</td>
<td>.11</td>
<td>.09</td>
<td>.11*</td>
<td>.11</td>
</tr>
<tr>
<td>AH acc</td>
<td>−.24</td>
<td>.15</td>
<td>.12</td>
<td>.05*</td>
<td>.05</td>
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<tr>
<td><strong>Academic performance-T</strong></td>
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<tr>
<td>Status</td>
<td>.25</td>
<td>.14</td>
<td>.12</td>
<td>.14**</td>
<td>.14</td>
</tr>
<tr>
<td>AH acc</td>
<td>.33</td>
<td>.23</td>
<td>.20</td>
<td>.09*</td>
<td>.09</td>
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</table>

Note. \( \beta \) = standardized regression coefficient; \( \Delta R^2 \) = change in \( R^2 \); \( sr^2 \) = semipartial correlations; Status = children’s social status/aggressiveness; AH acc = ratio of accuracy for Children’s Attentional Shifting Task trials involving shifts from angry to happy facial expressions; Down regulation-P = parent’s report of child’s need for help in down regulating strong emotions (higher scores = less regulation); Self-control-P = parent’s report of child’s self-control (higher scores = less control); Academic performance-T = teacher’s report of child’s academic performance.

*p < .10. *p < .05. **p < .01. ***p < .001.
Parents’ Reports of Emotion Regulation

In the first step of analyses evaluating the contributions of the CAST to children’s emotion regulation (Down-regulation) as rated by parents, status explained 14% of the variance in children’s emotion regulation skills, $R^2 = .14, F_{inc}(1, 52) = 8.77, p = .005$. In the second step, performance on the CAST accounted for an additional 7% of unique variance, $R^2 = .21, F_{inc}(1, 51) = 4.24, p < .05$.

Parents’ Reports of Self Control

In the first step, children’s status made a significant contribution, explaining 11% of the variance in children’s self-control, $R^2 = .11, F_{inc}(1, 52) = 6.09, p = .02$. In the second step, there was a trend for shifting attention away from angry faces to explain significant variance, $R^2 = .15, F_{inc}(1, 51) = 2.92, p = .09$. Performance on the CAST explained 5% of the unique variance in parents’ reports of children’s self-control.

Teachers’ Reports of Children’s Academic Performance

On the first step, status explained 14% of the variance in children’s academic performance, $R^2 = .14, F_{inc}(1, 51) = 8.13, p = .006$. The ability to shift attention away from angry faces on the CAST was entered on the second step and explained an additional 9% of the unique variance, $R^2 = .23, F_{inc}(1, 50) = 5.95, p = .02$. Together status and attention shifting explained 23% of variance in children’s academic performance.

Discussion

The results of this study suggest that the CAST is developmentally appropriate for kindergarten and first-grade children. Our analyses indicate that the presentation time for CAST trials was sufficient for early grade school children. The nonsignificant result for proportion correct and the significant decrease in reaction times indicate that 40 trials did not fatigue kindergarten and first-grade children, nor did children appear to lose interest or motivation over the length of the task, because reaction times decreased over the four trial blocks. Therefore, 40 may indicate an ideal number of trials to obtain representative data about a child’s performance without inducing boredom or fatigue.

Our findings also provide preliminary support for the concurrent validity of the CAST. The positive relation between laboratory (CAST) and teacher report measures is important in suggesting that the CAST and the Attentional Shifting scale of the CBQ converge on the same underlying mechanism, the ability to shift attention. Although previous research has found relations between the CBQ Inhibitory Control subscale and laboratory measures (e.g., Gonzalez, Fuentes,
Caranza, & Estevez, 2001; Kochanska, Murray, & Coy, 1997), we know of no other studies that have demonstrated this degree of specificity in the case of attention. For example, Gonzalez et al. found greater Stroop interference for children scoring low on the CBQ Inhibitory Control scale but not the Attention scales. It is possible that Stroop performance, which requires the child to inhibit the tendency to read a word, relates best to the CBQ Inhibitory Control scale because both measures assess the ability to engage in behavioral inhibition. In contrast, performance on the CAST may capture the more specific attentional aspects of self-regulation.

We also found that performance on the CAST predicted two important indicators of competence in young children: the ability to regulate emotions and early academic performance. The finding that the CAST predicts children’s emotion regulation skills supports previous research linking emotion regulation to parent and teacher reports of children’s ability to manage attention effectively from the CBQ and extends this research to a laboratory measure of attention shifting (Eisenberg et al., 1994). Previous research has found associations between attention and children’s school performance, but we know of no other research that has linked a specific aspect of attention, such as attention shifting, to children’s academic achievement (NICHD ECCRN, 2003). These findings regarding academic performance highlight the important role of attention in children’s school performance and suggest that interventions that increase children’s attention skills should also facilitate their performance in school.

Together, the results of this study suggest that the CAST provides a developmentally appropriate and valid format for assessing attentional shifting between affective stimuli in early grade school children. The CAST may also be useful for assessing relations between motivation and cognitive processes during other developmental periods, but in future research, researchers need to determine if this task is appropriate for younger children, adolescents, and adults. We are currently addressing this issue by assessing 4.5- to 5.5-year-old children. In addition, further research is needed on the validity of the CAST, and researchers should assess these variables in a larger sample of children. It also would be helpful to investigate the degree to which the CAST assesses the general ability to shift attention versus the ability to shift attention between different affective states. To evaluate this issue, future research should compare individuals’ performance on the CAST with their performance on other measures of attentional shifting that do not involve affective stimuli.

NOTE

1. The variability in the number of each type of trial on the CAST (e.g., 10 or 14 for critical trials) occurred because of an error in the original programming for this task. This error has been corrected in the revised CAST. Analysis indicated that groups did not vary in the number of critical trials completed.
REFERENCES


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