

INTRODUCTION

It has recently been speculated that emotion and cognition are dynamically linked throughout development (Bell & Wolfe, 2004; Blair, 2002; Bush, Luu & Posner, 2000; Fox, 1994; Rothbart & Derryberry, 1981; Ruff & Rothbart, 1996). Developmental cognitive neuroscience work suggests that similar underlying neural mechanisms may support cognitive and emotional processes (Bell & Wolfe, 2004), indicating that these relations may be examined through a brain/behavior approach. This line of work has focused primarily on infant and early childhood populations (Wolfe & Bell, 2004). Therefore, the purpose of the current study was to examine the relation between cognitive-based attention and temperament-based (emotion) attention in later normative development. Cognitive-attention and emotion-attention were hypothesized to be positively correlated. Additionally, successful performance on the cognitive-attention task was hypothesized to require greater activation in frontal and parietal areas associated with attentional networks.

PARTICIPANTS



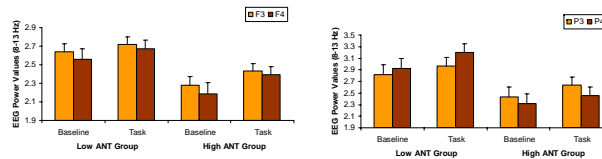
Thirty-three 8-year-old children (17 male, 16 female) were recruited through the Virginia Tech Developmental Sciences database. Behavioral and physiological data were collected. Children were born to middle- and upper-middle-class parents with at least a high school diploma. The sample was predominantly Caucasian. Thirty-one children contributed complete data for analysis.

PROCEDURE

Children completed the computerized child Attentional Network Task (Rueda, et al., 2004) designed to tap three attentional networks associated with different brain regions (alerting-frontal, parietal; orienting-frontal, parietal; conflict-frontal). EEG was recorded during baseline and task. EEG power was calculated for the alpha frequency band (8-13 Hz). Children also responded to the Early Adolescent Temperament Questionnaire (EATQ-R; Ellis & Rothbart, 1999; McKeen & Campbell, 2001).

COGNITIVE-ATTENTION & EEG

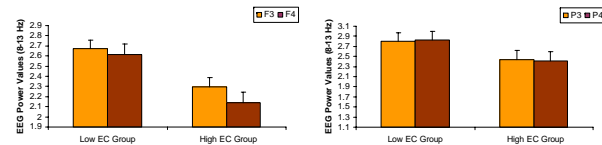
Participants were divided into high and low overall performance (percent accuracy) groups on the ANT using a median split. Based on Posner's attentional networks, the EEG power values from frontal and parietal scalp locations were examined.



There was a main effect of ANT performance group at the medial frontal (F3/F4) sites ($F(1,28)=7.122, p=.013$) and parietal (P3/P4) sites ($F(1,28)=6.539, p=.016$). Children in the high ANT performance group showed greater EEG activation (i.e., lower power values) during both baseline and task relative to children in the low ANT performance group. This effect was evident at both frontal and parietal scalp locations.

EMOTION-ATTENTION & EEG

Participants were divided into high and low effortful control groups based on a mean split of self-report EATQ-R temperament ratings. Effortful control is a subordinate temperament dimension comprised of attention, inhibitory control, and activation control subscales.



The high effortful control group showed greater baseline activation in frontal sites (F3/F4) relative to the low effortful control group ($F(1,29)=9.487, p=.004$), with no difference seen between high and low effortful control groups in parietal (P3/P4) regions ($F(1,29)=2.846, p=.102$).

TASK & SELF-RATED ATTENTION

Count	eatqgrp		Total
	1.00	2.00	
percentaccgroup	1.00	4	15
2.00	4	12	16
Total	15	16	31

The self-report ratings of the effortful control dimension of temperament was positively correlated with overall ANT performance ($r=.44, p=.01$). Seventy-five percent of children who rated themselves high on effortful control on the EATQ-R (as determined by a mean split) scored higher on overall performance on the child ANT (as determined by a median split), while 73% of children rating themselves low on effortful control scored lower on the child ANT ($\chi^2(1) = 7.242, p = .007$).

CONCLUSION

Children scoring higher on the child ANT showed greater activation in frontal and parietal areas during baseline and task relative to children scoring lower on the ANT. This finding is consistent with the attentional networks reported by Posner and colleagues to be activated during this task (Fan, McCandliss, Somer, Raz, & Posner, 2002). Similar neural mechanisms were associated with self-report of effortful control. Children rating themselves higher in effortful control showed greater baseline activation in the same frontal regions indicated as necessary for successful performance on the child ANT relative to children rating themselves lower on effortful. This finding is consistent with recent work in infancy and early childhood showing similar neural underpinnings supporting emotional and cognitive processes (Wolfe & Bell, 2004). Behavioral findings also showed a positive correlation between effortful control and overall performance on the child ANT. Interestingly, child report of effortful control prior to the ANT assessment predicted ANT performance. In conclusion, emotion-attention as assessed by self-report of effortful control on the EATQ-R was related to cognitive-attention as assessed by overall performance on the child ANT. The medial frontal region implicated in both processes has been associated with success on conflict tasks and may hold the key to furthering our understanding of the integration of emotion and cognition in development.