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Attentional fluctuations in preschoolers: Direct and indirect relations with task accuracy, academic readiness, and school performance

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ABSTRACT

Attentional control fluctuates in the presence of internal and external distractors, wandering on and off a given task. The current study investigated individual differences in attentional fluctuations in 250 preschoolers. Attentional fluctuations were assessed via intra-individual variability in response time in a Go/No-Go task. Greater fluctuations in attentional control were linked to lower task accuracy. In addition, greater attentional fluctuations predicted lower performance in a task of cognitive flexibility, the Dimensional Change Card Sort task. Attentional fluctuations were also associated with laboratory measures of academic readiness in preschool, as assessed by the Applied Problems and Letter–Word Identification subscales of the Woodcock–Johnson III Tests of Achievement, which in turn predicted teacher reports of academic performance in first grade. Attentional fluctuations also had indirect associations with emergent math skills in preschool, via cognitive flexibility, as well as indirect associations with first-grade teacher reports of academic performance, via the relations between cognitive flexibility and emergent math skills in preschool. These results suggest that consistency is an important aspect of attentional control during early childhood.

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Introduction

Attentional control is the ability to sustain attention on a task in the presence of internal and external distractors (Engle & Kane, 2004). In children, attentional control is associated with foundational cognitive assets such as language, memory, and intelligence (Astheimer & Sanders, 2012; Astle, Nobre, & Scerif, 2010; Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005). Furthermore, it is a strong predictor of school readiness and success (Allhusen et al., 2003; Blair & Diamond, 2008; Rueda, Checa, & Rothbart, 2010). Given the notable connections between attentional control and other critical cognitive functions and academic skills, it is important to advance our understanding of this fundamental ability during early childhood. To date, a rich body of research informs us about various aspects of attentional control in young children (for reviews, see Posner, Rothbart, Sheese, & Voelker, 2014; Stevens & Bavelier, 2012). However, we still know very little about how a characteristic feature of attentional control, its susceptibility to fluctuations, manifests during early childhood.

Attention wanders on and off a given task, fluctuating even in the absence of salient external distractors (Esterman, Noonan, Rosenberg, & Degutis, 2013). Previous work with adults demonstrated that greater fluctuations in attention predicted impairments in task performance (Bellgrove, Hester, & Garavan, 2004; Haynes, Bauermeister, & Bunce, 2017; Unsworth & McMillan, 2014). Importantly, individuals who were more susceptible to attentional fluctuations showed poorer performance not only during the task in which fluctuations were measured but also in other fundamental cognitive functions, including working memory, prospective memory, and fluid intelligence (Ihle, Ghisletta, & Kliegel, 2017; Kane et al., 2016; Larson & Saccuzzo, 1989; Unsworth, 2015). Furthermore, fluctuations of attentional control are heightened in a wide spectrum of clinical populations such as in individuals with Alzheimer's disease, schizophrenia, depression, and borderline personality disorder (Duchek et al., 2009; Kaiser et al., 2008). These findings suggest that heightened attentional fluctuations in adults are associated with impairments in broader cognitive performance. Such findings underscore the importance of characterizing attentional fluctuations during early childhood because this line of inquiry lays the groundwork for understanding pathways to consistent control of attention throughout development. Furthermore, such investigations can inform interventions meant to promote attentional control during childhood and beyond. The goal of the current study was to examine how individual differences in attentional fluctuations manifest during the preschool period, a pivotal time of rapid development in attentional skills (Posner et al., 2014).

In adults, the frequency of lapses in attentional control during a task can be approximated via thought-probe measures that ask participants to report whether they are on- or off-task or to rate their attentional engagement at any given moment (Kam, Dao, Stanciulescu, Tildesley, & Handy, 2013; Unsworth & McMillan, 2014). Although such measures give a reasonable proxy for lapses in attentional control in adults, they are inevitably limited by subjective experiences of lapses and might not capture attentional fluctuations that occur outside of awareness yet still have behavioral consequences (Kane et al., 2016). Furthermore, such measures cannot be used with young children whose metacognitive abilities are still developing (Flavell, Green, & Flavell, 2000). Therefore, a simple and age-appropriate measure that does not rely on subjective experience is needed to index fluctuations in attentional control in young children. Previous work has shown that attentional fluctuations during a task can be measured via intra-individual variability in response time (Esterman et al., 2013; Fortenbaugh et al., 2015; Unsworth, 2015). Attentional fluctuations can contribute to response time variability through at least two mechanisms. First, lapses in attentional control can lead to goal neglect (Unsworth, Redick, Lakey, & Young, 2010). When a child is "in the zone," task-relevant goals are maintained consistently. However, when lapses in attentional control happen—in other words, when the child is "out of the zone"—the goal of the task is not maintained efficiently and goal neglect occurs. In the presence of goal neglect, habitual responses can dominate the behavior. Thus, prepotent tendencies to respond take over and responses much faster than the average are observed. Second, lapses in attentional control can slow down cognitive processes. When a child is out of the zone due to lapses in attentional control, attention needs to be redirected to get back in the zone. This redirection of attention for task-relevant behavior takes time. In such cases, responses can occur much slower than

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