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Exploring dimensionality of effortful control using hot and cool tasks in a sample of preschool children

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ABSTRACT

Effortful control (EC) is an important developmental construct associated with academic performance, socioemotional growth, and psychopathology. EC, defined as the ability to inhibit or delay a prepotent response typically in favor of a subdominant response, undergoes rapid development during children's preschool years. Research involving EC in preschool children can be aided by ensuring that the measured model of EC matches the latent structure of EC. Extant research indicates that EC may be multidimensional, consisting of hot (affectively salient) and cool (affectively neutral) dimensions. However, there are several untested assumptions regarding the defining features of hot EC. Confirmatory factor analysis was used in a sample of 281 preschool children (M_{age} = 55.92 - months, SD = 4.16; 46.6% male and 53.4% female) to compare a multidimensional model composed of hot and cool EC factors with a unidimensional model. Hot tasks were created by adding affective salience to cool tasks so that hot and cool tasks varied only by this aspect of the tasks. Tasks measuring EC were best described by a single factor and not distinct hot and cool factors, indicating that affective salience alone does not differentiate between hot and cool EC. EC shared gender-invariant associations with academic skills and externalizing behavior problems.

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Introduction

Effortful control (EC) is an important individual difference in temperament that affects numerous aspects of young children's typical and atypical development (Allan & Lonigan, 2011; Blair & Razza, 2007; Nigg, 2006; Posner & Rothbart, 2000). For example, in preschool- and kindergarten-age samples, EC is associated with and predictive of academic performance and school readiness (Blair & Razza, 2007), social functioning and relationships with parents and peers (Eisenberg et al., 2000; Kochanska, Murray, & Harlan, 2000), and internalizing and externalizing behavior problems (Allan & Lonigan, 2011; Espy, Sheffield, Wiebe, Clark, & Moehr, 2011; Kochanska, Barry, Jimenez, Hollatz, & Woodard, 2009). Although it is clear that EC is associated with other developmentally important constructs, research into the mechanisms underlying these associations is hindered by an apparent conflict between how aspects of EC are conceptualized and how they are operationalized. Emerging evidence suggests that EC may be best conceptualized as made up of a hot (affectively salient) factor and a cool (affectively neutral) factor, but it is unclear whether affective salience alone distinguishes between hot and cool EC.

EC is considered the regulatory dimension of temperament, and as such it has dynamic relations with the reactive temperament dimensions (i.e., extraversion/surgency and negative affectivity; Gartstein, Putnam, & Rothbart, 2012). Whereas extraversion/surgency and negative affectivity appear early in infancy (e.g., Kagan & Fox, 2007), EC tends to develop later. In general, EC can be measured by around 2½ years of age (Rothbart, Posner, & Kieras, 2006), and it tends to undergo a period of rapid development during the preschool years (e.g., Zelazo & Carlson, 2012). Behaviorally, EC is defined as the ability to delay or inhibit a prepotent response, typically in favor of a subdominant response. EC is considered important for the flexible handling of situations that arise in the environment as well as in executing goal-directed behavior (Rothbart et al., 2006).

Research on EC has been hindered by confusion regarding whether effortful control is distinct from other similarly defined self-regulation terms. The confusion often lies in determining whether EC and executive functioning (EF) are two related but distinct constructs or the same construct with different labels (Allan & Lonigan, 2011; Willoughby, Kupersmidt, Voegler-Lee, & Bryant, 2011). Some researchers argue that EF and EC are indistinguishable from each other (Zhou, Chen, & Main, 2012). However, there are important distinctions between EF and EC; although EF does contain a construct that is similar to EC labeled inhibitory control (IC), it also contains additional distinct cognitive constructs (i.e., working memory, shifting/updating; Miyake et al., 2000) that are dissociable from IC in adults and children (McAuley & White, 2011; Miyake et al., 2000). Therefore, given that the same behavioral tasks are used to measure IC and EC and research from one tradition is commonly cited in the other tradition (e.g., Allan & Lonigan, 2011; Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Kim, Nordling, Yoon, Boldt, & Kochanska, 2013; Willoughby et al., 2011), the overlap between EC and EF is specific to IC. For the purpose of clarity, constructs in prior studies that fit the definition of EC in this study are referred to as such.

Recently, researchers across multiple psychology disciplines (e.g., developmental, neuropsychological, cognitive) have suggested that EC may consist of hot and cool dimensions in young children (i.e., preschool and kindergarten age; e.g., Kerr & Zelazo, 2004; Metcalfe & Mischel, 1999; Willoughby et al., 2011; Zelazo & Müller, 2002). Both hot and cool EC are purported to be activated in situations or tasks for which the suppression or delay of a prepotent response is required. The difference is that for hot EC there is a proximal affective or emotional stimulus, whereas for cool EC there is not an affective or emotional stimulus. In studies that have examined whether hot and cool factors emerge in young children, hot tasks have been defined as those for which a proximal extrinsic reward or punishment for performance is included (i.e., response–gain or response–cost tasks) and cool tasks have been defined as those for which no extrinsic motivator for performance is included, although it is recognized that the difference between hot and cool EC is likely to be dimensional to some degree (e.g., Brock et al., 2009; Hongwanishkul, Happaney, Lee, & Zelazo, 2005; Kim et al., 2013; Willoughby et al., 2011).

Neurobiological research regarding EC has provided some evidence that there are distinctions in the neural substrates associated with hot versus cool EC. Whereas early research on EC and neural systems focused almost exclusively on the prefrontal cortex (PFC), there is emerging evidence that different neural systems may be more or less involved depending on whether hot or cool EC is necessary. It