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A review of the day–night task: The Stroop paradigm and interference control in young children

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ABSTRACT

The day–night task is a widely used measurement of interference control in young children between ages 3 and 7. This integrative review examines the development of interference control by describing day–night task performance. We outline essential task demands and task variants, describe theoretical explanations of performance, highlight key methodological concerns relevant to future research, and speculate upon the neural events that likely correspond to distinct components of task performance. The review concludes with suggestions for future investigation.

Introduction

Humans are commonly faced with situations and problems where the obvious and practiced response must be suppressed in favor of a nonobvious, but appropriate, response. Perhaps the most widely used measurement of adults' negotiation of such conflicts is the Stroop test (Stroop, 1935) which presents a set of color words printed in various ink colors and asks participants to either read the words or state the ink color across a series of trials. Naming ink colors when they conflict with the printed text (e.g., red printed in green ink) is significantly more difficult than when text and color are congruent. While this conflict is sometimes referred to in the literature as taxing *inhibitory control*, we defer in this paper to the traditional terminology describing Stroop measurements as tests of *interference control* (e.g., MacLeod, 1991). Briefly stated, interference control is the ability to suppress a dominant response related to perceptual stimuli in the task while selecting and executing a competing, conflicting subdominant response (Barkley, 1997; Kipp, 2005).

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Unfortunately, the Stroop test has limited effectiveness with preschoolers and young children because it presupposes literacy. Even among children who are literate, the wide variability in their literacy skills can confound performance (van Mourik, Oosterlaan, & Sergeant, 2005). As recently as 1991, MacLeod in his landmark review of the Stroop effect, concluded that "attempts to create Stroop-like situations for younger, prereading children have not been very informative" (p. 185). However, coinciding with surging interest in the development of executive functioning in preschoolers (Garon, Bryson, & Smith, 2008; Hughes, 2002), the intervening years have witnessed new attempts to circumvent the literacy requirement and adapt the Stroop paradigm to young children (Gerstadt, Hong, & Diamond, 1994; Prevor & Diamond, 2005; Quinn & Quinn, 2005; Wright, Waterman, Prescott, & Murdoch-Eaton, 2003). The most widely used Stroop-like task developed for young children is the day–night task (Gerstadt et al., 1994) and it is the focus of this review. In particular, we aim to integrate the task-related literature as it bears on the development of interference control in young children.

The day–night task is found in very disparate areas of the literature. While the dissimilarities in purpose and context testify to the breadth of its utility and importance to a number of domains of child psychology, the result is a fractionated picture of precisely what the task is measuring and, moreover, whether developmental and individual differences in performance on the task emerge with any consistency. Placing the task within an integrative, coherent framework is necessary for addressing these basic questions.

Detailing the processes underlying day–night task performance among young children will also enhance subsequent efforts to construct a full developmental picture of executive function (EF). *Executive function* is a general umbrella term that connotes a variety of cognitive abilities such as attention, planning, inhibition, and maintaining and organizing information in working memory. Task impurity (i.e. EF tasks tapping more than one EF-related process) is a persistent problem in the EF literature and it highlights the need for detailed and integrative task analyses of broadly used measurements like the day–night task (see Beveridge, Jarrold and Pettit (2002) and Friedman and Miyake (2004)). Proper interpretation of how and why the day–night task relates to various EF measurements, and to other related constructs, clearly pivots on determining what construct(s) the task primarily measures.

Additionally, a coherent picture of EF integrating its early development with later development occurring into adulthood is generally lacking in the literature (Best, Miller, & Jones, 2009; Garon et al., 2008). A review of the day–night task is potentially well-suited to address this shortcoming given the extensive literature devoted to understanding Stroop performance among adults (MacLeod, 1991).

Day–night task

Overview

In the original and standard administration of the day–night task (Gerstadt et al., 1994), children (between ages 3½ and 7, the focal ages for this review) were instructed to say the word 'day' when viewing a card depicting a nighttime sky and to say 'night' when shown a picture of the daytime sky. Like the adult Stroop test, children had to (a) maintain task instructions over a series of trials, (b) suppress a dominant response associated with a perceptual stimulus while (c) selecting and executing a competing, conflicting subdominant response. These requirements distinguish the task from other common inhibitory tasks measuring the related constructs of *behavioral inhibition* (suppressing a primed response) and *set-shifting* (switching from previously learned task instructions to new ones) (see Table 1).

A control version in which two sets of cards depicted neutral designs (e.g., a checkerboard) was also administered. Overall, children made significantly more errors on the day–night task than on the control task (see Table 2). Response latency was significantly longer for the day–night task than for the control task and children generally made more errors as testing progressed during the 16 trials. For younger preschoolers (3½–4½), accuracy tended to be inversely related to response time with children making fewer errors when they took longer to respond.