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# Where does prepotency come from on developmental tests of inhibitory control?

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ABSTRACT

Understanding the processes that make responses prepotent is central to understanding the role of inhibitory control in cognitive development. The question of what makes responses prepotent was investigated using the two most widely studied measures of preschoolers' inhibitory control. Across two experiments, 80 children were tested either on a series of stimulus–response compatibility (SRC) tasks or on a series of Go/No-go tasks. Results indicated that high levels of prepotency on SRC tasks (such as the Day/Night task) occur only under specific conditions; making a *verbal* response can be highly prepotent *if* the stimulus and response are associated with each other (e.g., saying "cup" to a cup) but is less prepotent when they are unassociated (e.g., saying "cup" to a doorstop). *Action* responses (e.g., lifting a cup to your mouth) show little prepotency irrespective of whether the stimulus and response are associated. In contrast, with Go/No-go tasks, a much wider variety of behaviors are highly prepotent regardless of whether the stimulus and response are associated. These data suggest that prepotency arises in very different ways, depending on the type of task used. Although both Go/No-go tasks and SRC tasks can make inhibitory demands, they do so for fundamentally different reasons.



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## Introduction

Inhibitory control is the ability to suppress cognitions and behaviors that are incompatible with current goals. Inhibitory control undergoes protracted development from infancy to adulthood, with particularly marked changes between 2 and 5 years of age (Garon, Smith, & Bryson, 2014; Johansson, Marciszko, & Brocki, 2016; Petersen, Hoyniak, McQuillian, Bates, & Staples, 2016; Simpson & Riggs, 2005b; Wiebe, Sheffield, & Espy, 2012). Although research clearly suggests that inhibitory control improves with age, this is only one part of a more complex story. To understand the place of inhibitory control during development, it is also necessary to understand how inhibitory demands are created in the first place—in other words, to understand where prepotency comes from (Simpson et al., 2012). A prepotent response is a response that would be made in a given situation *without* active reflection—that is, in the absence of intentional top-down control. In most instances, making a prepotent response is goal appropriate (such as eating a delicious piece of chocolate). However, sometimes pursuing a goal requires that prepotent responses are inhibited so that other more goal-appropriate behavior can be made instead (such as not eating a piece of chocolate in order to lose weight).

Understanding how prepotency is created is important for four reasons (Simpson et al., 2012). First, understanding this process is necessary to identify which tasks require inhibitory control; only tasks that contain inappropriate prepotent responses will be inhibitory (e.g., Simpson, Cooper, Gillmeister, & Riggs, 2013). Second, understanding this process in the laboratory will help us to understand when and why preschoolers' weak inhibitory control is exposed outside it. Correlational evidence suggests that improvements in inhibitory control are associated with the development of many important skills (e.g., Apperly & Carroll, 2009; Beck, Carroll, Brunsdon, & Gryg, 2011; Benson, Sabbagh, Carlson, & Zelazo, 2013; Cragg & Gilmore, 2013; Riggs, Jolley, & Simpson, 2013; van Mourik, Oosterlaan, & Sergeant, 2005). Nevertheless, it is not clear *why* inhibitory control is associated with these skills. A crucial question is the following: Does the presence of inappropriate prepotent responses directly block the expression of these skills? To answer this question, we need to understand the conditions that create prepotent responses. Third, the pattern of prepotency may change during development. Behavior that is prepotent at one point during development might not be prepotent at another point. Finally, understanding prepotency can help us to identify strategies to enable children to circumvent their inhibitory weakness (e.g., Simpson et al., 2012).

When seeking to understand how prepotency is created, we suggest that the best place to start is to consider measures of inhibitory control. A meta-analysis of developmental studies reported that approximately 70% of all studies of inhibitory control used two measures: stimulus–response compatibility (SRC) tasks and Go/No-go tasks (Petersen et al., 2016). In the current study, we aimed to determine why responses are prepotent in these two measures.

Developmental inhibitory control tasks typically present children with a stimulus that evokes a prepotent response, which must then be inhibited. For example, on SRC tasks—a family of tasks that include the Day/Night task and the Grass/Snow task—children are shown one of two stimuli and are asked to make one of two responses. On the Day/Night task, children must respond by saying "night" when they see a picture of a |sun| and by saying "day" when they see a picture of a |moon|. Crucially, the correct response on the task is to make a response that is different from the stimulus on that trial. Children must inhibit the tendency to make the response that is triggered by the stimulus (i.e., seeing |sun| triggers the incorrect response of saying "day") in order to make the task-appropriate response instead (i.e., seeing |sun| and then saying "night").

So where does this to-be-inhibited prepotency come from? One suggestion has been that prepotency on these tasks arises from a combination of two factors: intention and stimulus–response association (Simpson & Riggs, 2007). *Intention* refers to children specifically intending to make one or more particular responses on the task—typically because the task instructions explicitly direct them to do so. For example, on the Day/Night task, children are instructed to say either "day" or "night." Because children intend to make these two responses on the task, these two responses become primed (i.e., partially activated). *Stimulus–response association* refers to the stimuli and responses on a task being associated with each other, usually through previous experience. For example, a picture of a |moon|