Cognitive Development 28 (2013) 354–363

Contents lists available at ScienceDirect

Cognitive Development

Interference suppression vs. response inhibition: An explanation for the absence of a bilingual advantage in preschoolers' Stroop task performance

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ARTICLE INFO

Article history:
Received 18 October 2012
Received in revised form 3 July 2013
Accepted 10 September 2013

Keywords:
Bilingual advantage
Inhibition
Preschool
Stroop
Executive function
Interference suppression

ABSTRACT

The well-documented advantage that bilingual speakers demonstrate across the lifespan on measures of controlled attention is not observed in preschoolers' performance on Stroop task variations. We examined the role of task demands in explaining this discrepancy. Whereas the Color/Word Stroop used with adult participants requires interference suppression, the Stroop task typically used with preschoolers requires only response inhibition. We developed an age-appropriate conflict task that measures interference suppression. Fifty-one preschool children (26 bilinguals) completed this new Bivalent Shape Task and the Day/Night task used in previous research. Bilingual in comparison to monolingual children performed better on incongruent trials of the Bivalent Shape Task, but did not differ on other measures. The results indicate that the discrepancy between preschoolers and older individuals in performance on Stroop task adaptations results from characteristics of the task rather than developmental differences. Further, the findings provide additional support for the importance of interference suppression as a mechanism underlying the bilingual advantage.

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http://dx.doi.org/10.1016/j.cogdev.2013.09.002

1. Bilingual advantage

The regular use of two or more languages benefits controlled attention, with advantages found among bilingual preschoolers, school-aged children, and adults on a variety of tasks requiring controlled attention (for reviews, see Adesope, Lavin, Thompson, & Ungerleider, 2010; Hilchey & Klein, 2011). This bilingual advantage arises in part from the management of two (or more) linguistic representations, which results in extensive practice in selective attention and cognitive flexibility. Among preschoolers, the differences between bilingual and monolingual children vary across tasks. Bilinguals show an advantage on conflict tasks such as the Simon task (Martin-Rhee & Bialystok, 2008), the Dimensional Change Card Sort (Bialystok & Martin, 2004), and the Attentional Network Task (Yang, Yang, & Lust, 2011). In contrast, comparable performance is found on age-appropriate variants of the Stroop task (Martin-Rhee & Bialystok, 2008; Siegal, Iozzi, & Surian, 2009), although Stroop tasks reliably differentiate monolingual and bilingual adults (Bialystok, Craik, & Luk, 2008; Hernández, Costa, Fuentes, Vivas, & Sebastián-Gallés, 2010).

Although this pattern of results could have a developmental explanation, it may be attributable to differences among the tasks used to measure the Stroop effect across the lifespan. The studies documenting a bilingual advantage with adults utilized tasks with bivalent stimuli; participants responded to images that contained both relevant and distracting information. Responding correctly thus required suppressing the irrelevant content. The investigations with preschool aged children used the commonly employed Day/Night task (Gerstadt, Hong, & Diamond, 1994), which has a univalent display. There is no perceptually distracting information in the stimuli to require suppression, an aspect of attention regulation that contributes to the bilingual advantage.

In this investigation, we examined the role of task demands in explaining the absence of a bilingual advantage in Stroop task adaptations among preschoolers. We developed an age-appropriate task for preschoolers that has bivalent conflict in the stimuli, similar to the classic Color/Word Stroop. We tested for the presence of a bilingual advantage in the performance of this task. In an attempt to replicate previous findings, we also included the Day/Night task. We expected to observe a bilingual advantage only with the new Bivalent Shape Task, providing evidence that age differences in performance are due not to developmental changes but to task requirements.

1.1. Defining Stroop

Stroop (1935) designed the Color/Word Stroop task to measure interference between potentially conflicting stimulus dimensions. The task is bivalent in that color word names are presented printed in colored ink. The test items can be congruent, when the color word is consistent with the color of ink in which it is printed, or incongruent, when the color word and the color of ink do not correspond (e.g., the word “green” printed in blue ink). Participants respond to congruent and incongruent items within the same set of trials (mixed block) and must inhibit the prepotent reading response in order to answer correctly with the color of the ink in which the color name is printed. In comparison to performance on congruent trials, incongruent trials are more challenging, as evidenced by slower response times and lower accuracy.

Gerstadt et al. (1994) developed the Day/Night task as an alternative for young children to circumvent the need for well-developed literacy. In this task, children are presented with univalent pictures of a sun and a moon. Participants are asked to respond to the pictures by saying “night” to the sun and “day” to the moon, representing an incongruent response. A correct response requires the maintenance of task instructions and the inhibition of a dominant response pattern, but does not require inhibiting irrelevant distracting perceptual information.

Existing variations of the Day/Night task are not ideal for work with bilingual preschoolers for several reasons. For instance, both the Sun/Moon task (Archibald & Kerns, 1999) and the 4 Pairs task (Livesey, Keen, Rouse, & White, 2006) require an opposite response to a univalent picture, but present no distracting perceptual information. The Big/Little Stroop (Kochanska, Murray, & Harlan, 2000), and the Shape Stroop (Poulin-Dubois, Blaye, Coutya, & Bialystok, 2011) are bivalent in that