Journal of Experimental Child Psychology xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

journal homepage: www.elsevier.com/locate/jecp

Brief Report

Real-time coordination of visual and linguistic processes in novice readers

Yi Ting Huang

Department of Hearing and Speech Sciences, University of Maryland College Park, College Park, MD 20742, USA

ARTICLE INFO

Article history:
Received 22 August 2017
Revised 23 February 2018
Available online xxxx

Keywords:
RAN task
Novice readers
Eye-tracking
Reading development
Parafoveal preview
Eye-voice overlap

ABSTRACT

Skilled reading requires coordinating real-time visual fixations, orthographic analyses, and phonological encoding across multiple words in sentences. These procedures are well studied in experienced readers, but less is known about their status during development. To investigate how visual properties influence the origins of coordinated processing, the current study combined rapid automatized naming (RAN) with an eye-tracking paradigm and compared the timing of fixations and vocalizations in typically developing adults and 6-year-old children. Within RAN displays, sequences varied visual features of items (i.e., similar such as *p–q* vs. dissimilar such as *p–t*) and their locations in rows (i.e., row-initial vs. row-medial positions). Adults and children accessed parafoveal preview of subsequent items when fixating on current items, leading to longer latency to speak for similar items compared with dissimilar ones. Both groups also vocalized previous items while fixating on current items, leading to longer eye–voice overlap for row-medial items compared with row-initial ones. Yet, relative to adults, children exhibited exaggerated delays in latency to speak from parafoveal preview and reduced eye–voice overlap due to row transitions. Together, this suggests that coordinated processing is present at the earliest points of development but that greater inexperience increases susceptibility to momentary visual hurdles. Relationships to previous work on real-time RAN performance in dyslexic adults and children are discussed.

E-mail address: ythuang1@umd.edu

https://doi.org/10.1016/j.jecp.2018.02.010
0022-0965/

Introduction

Skilled reading forms the basis for education and communication, but its ubiquity masks its underlying complexity. To extract meaning from text, readers must visually analyze and linguistically retrieve properties of multiple words in sentences. As such, they must negotiate the need to move forward to not forget prior material with the potential for confusion when too much information is concurrently available. These decisions occur seamlessly in adults, but less is known about how they unfold in children. To examine coordinated processing in less experienced populations, past studies have relied on the rapid automatized naming (RAN) task, which asks children to name letter or number displays as quickly and accurately as possible. Similar to reading, RAN performance requires targeting fixations, encoding orthographic properties, and accessing phonological features across simultaneously presented items (Fig. 1) (Breznitz, 2005; Gordon & Hoedemaker, 2016; Jones, Obregon, Kelly, & Branigan, 2008; Kuperman, Van Dyke, & Henry, 2016; Protopapas, Altani, & Georgiou, 2013a). Total response times are associated with current reading ability (Gordon & Hoedemaker, 2016; Wagner & Torgesen, 1987), future aptitude (Compton, 2003; Lervag & Hulme, 2009; Wagner et al., 1997), and impairment risk (Denckla & Rudel, 1976; Georgiou, Parrila, Manolitsis, & Kirby, 2011).

Importantly, recent advancements in eye-tracking have provided a window into the real-time dynamics of RAN performance. Much of this work investigates the processing correlates of reading impairments. For example, although all adults engage in parafoveal preview of subsequent items ($n + 1$) when fixating on current items (n) (Jones, Ashby, & Branigan, 2013; Jones, Snowling, & Moll, 2016; Jones et al., 2008), those with dyslexia experience greater interference from visually similar items (e.g., p–q) relative to non-dyslexic peers (Al Dahhan et al., 2014; Moll & Jones, 2013). Nevertheless, evidence from development remains mixed. Relative to non-dyslexic peers, dyslexic 10-year-olds demonstrate delayed naming rates and increased error for visually similar items (Al Dahhan, Kirby, Brien, & Munoz, 2017). This suggests access to parafoveal preview, much like that among adults. Yet, unlike non-dyslexic peers, dyslexic 10-year-olds show limited improvements in fixation duration for simultaneously presented items compared with individually presented ones (Yan, Pan, Laubrock, Kliegl, & Shu, 2013). This suggests less parafoveal preview compared with non-dyslexic peers. Similarly, recent work suggests that impairment status generates processing distinctions that go beyond developmental delays. Although total response times and error rates in dyslexic 10-year-olds are similar to those in non-dyslexic 7-year-olds, saccade and regression counts for visually similar items remain exaggerated in impaired populations (Al Dahhan et al., 2017).

However, prior focus on reading impairments leaves open questions of how coordinated processing unfolds during typical development. This creates challenges in interpreting population differences,

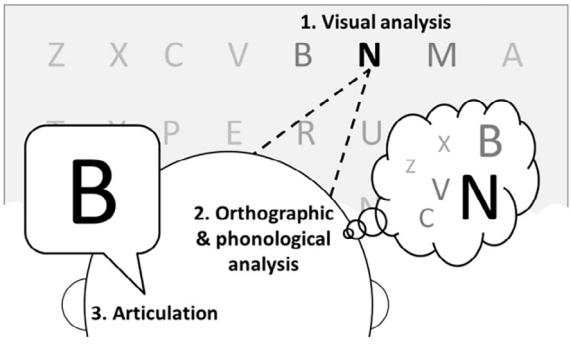

Fig. 1. Real-time RAN performance can be measured along multiple dimensions. Vocal duration assesses the time from the onset of articulating an item (e.g., B) to the offset of articulating the same item (e.g., B). Latency to speak assesses the time from the onset of fixating an item (e.g., N) to the onset of articulating the same item (e.g., N). Eye–voice overlap assesses the time from the onset of fixating a current item (e.g., N) to the offset of articulating the previous item (e.g., B). Total response time increases with vocal duration and latency to speak, but it decreases with eye–voice overlap.

Please cite this article in press as: Huang, Y. T. Real-time coordination of visual and linguistic processes in novice readers. *Journal of Experimental Child Psychology* (2018), https://doi.org/10.1016/j.jecp.2018.02.010