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The role of rapid naming in reading development and dyslexia in Chinese

Chen-Huei Liao [a], Ciping Deng [b], Jessica Hamilton [c], Clara Shuk-Ching Lee [c], Wei Wei [b], George K. Georgiou [c,*]

[a] Department of Special Education, National Taichung University of Education, Taiwan, ROC
[b] School of Psychology and Cognitive Science, East China Normal University, Shanghai, China
[c] Department of Educational Psychology, University of Alberta, Edmonton, Alberta T6G 2G5, Canada

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ABSTRACT

We examined in a series of studies the mechanism that may underlie the relationship between Rapid Automatized Naming (RAN) and reading (accuracy and fluency) in Mandarin Chinese. Study 1 examined the "arbitrary" connections hypothesis in a sample of Grade 2 children ($N = 182$). Study 2 contrasted the phonological processing, orthographic processing, and speed of processing hypotheses in a sample of Grade 2 children followed until Grade 5 ($N = 72$). Finally, Study 3 contrasted the same hypotheses in a sample of Grade 4 children with dyslexia ($n = 30$) and chronological-age controls ($n = 30$). The results indicated that (a) RAN is unrelated to Paired Associate Learning (PAL) tasks that tap the ability to form arbitrary connections between characters and their pronunciation, (b) controlling for nonverbal IQ and orthographic processing was sufficient to explain the RAN–reading accuracy relationship but not the RAN–reading fluency relationship, and (c) the observed differences between dyslexics and controls in RAN diminished after controlling for orthographic processing. Taken together, these findings suggest that RAN is related to reading accuracy (and partly to reading fluency) because children must access orthographic representations from long-term memory. Although accessing these representations is sufficient for accurate word recognition, it is not sufficient for fluent reading, which also requires efficient parafoveal processing.

* Corresponding author.
E-mail address: georgiou@ualberta.ca (G.K. Georgiou).

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Introduction

Rapid Automatized Naming (RAN), defined as the ability to name as fast as possible highly familiar stimuli such as digits, letters, objects, and colors, has been found to be a strong predictor of reading ability in different languages (e.g., Bowers, 1995; Cutting & Denckla, 2001; de Jong & van der Leij, 1999; Georgiou, Parrila, Cui, & Papadopoulos, 2013; Ho & Lai, 1999; Landerl & Wimmer, 2008; Lepola, Poskiparta, Laakkonen, & Niemi, 2005; Powell, Stainthorp, Stuart, Garwood, & Quinlan, 2007; Savage & Frederickson, 2005). Its popularity has grown, particularly after the findings of several studies showing that it predicts reading independently of other known correlates of reading such as letter knowledge, phonological awareness, vocabulary, short-term memory, and orthographic processing (e.g., Bowey, McGuigan, & Ruschena, 2005; Manis, Doi, & Bhadha, 2000; Pan et al., 2011; Parrila, Kirby, & McQuarrie, 2004; Powell et al., 2007; Savage & Frederickson, 2005).

Despite the acknowledged importance of RAN in predicting reading, researchers have not yet been able to identify the mechanism that is responsible for the RAN–reading relationship. As a result, several competing theoretical accounts have been proposed (Georgiou & Parrila, 2013). For example, Torgesen, Wagner, and colleagues (e.g., Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997; Wagner & Torgesen, 1987) have argued that RAN is part of the phonological processing construct and that it predicts reading because it taps the ability to access and retrieve phonological information from long-term memory. In turn, Bowers and colleagues (e.g., Bowers, Sunseth, & Golden, 1999; Bowers & Wolf, 1993), have argued that RAN is related to reading because of its contribution to orthographic processing. Finally, Kail and colleagues (e.g., Kail & Hall, 1994; Kail, Hall, & Caskey, 1999) have argued that RAN and reading are related because skilled performance in both naming and reading depends, in part, on the rapid execution of their underlying processes.

Not surprisingly, several studies have also shown that RAN predicts reading ability in Chinese (e.g., Chow, McBride-Chang, & Burgess, 2005; Ding, Richman, Yang, & Guo, 2010; Liao, Georgiou, & Parrila, 2008; Luo, Chen, Deacon, Zhang, & Yin, 2013; McBride-Chang & Ho, 2005; McBride-Chang & Kail, 2002; Pan et al., 2011; Tan, Spinks, Eden, Perfetti, & Siok, 2005; Yeung et al., 2011) and differentiates Chinese children with and without dyslexia (e.g., Chung, Ho, Chan, Tsang, & Lee, 2010; Chung et al., 2008; Ho, Chan, Lee, Tsang, & Luan, 2004; Ho, Chan, Tsang, & Lee, 2002; Ho & Lai, 1999; Li, Shu, McBride-Chang, Liu, & Xue, 2009; McBride-Chang et al., 2013; Shu, McBride-Chang, Wu, & Liu, 2006; Wang, Georgiou, Das, & Li, 2012). However, to our knowledge, no studies have systematically examined the mechanism underlying the RAN–reading relationship in Chinese.

Examining the relationship between RAN and reading in Chinese is important for several reasons. First, Chinese differs from English and other alphabetic orthographies in many respects. Chinese is a morphosyllabic language in which the role of phonology in word reading is not as strong as in English (Hanley, 2005). It has been estimated that only 23% to 26% (when tone is taken into account) of the Chinese characters can be read accurately using the phonetic radical (Chung & Leung, 2008; however, see also Zhou, 1978, for a higher estimate). If RAN is related to reading because it taps the ability to access and retrieve phonological representations from long-term memory, then its contribution to Chinese reading should be relatively weak.

Second, Chinese is perhaps the only orthography in which a variation of the orthographic processing account has been predominantly used to explain the unique contribution of RAN to reading. According to Manis, Seidenberg, and Doi (1999), RAN tasks may tap into children's ability to learn arbitrary associations between symbols and sounds, an ability that is also used in learning to read exception words. Because reading in Chinese requires learning arbitrary connections between characters and their pronunciation (e.g., seeing character "书book" does not equip the reader with its pronunciation "shu[1]," where the number in brackets refers to the tone), several researchers have endorsed this hypothesis to justify RAN's unique contribution to Chinese reading (e.g., McBride-Chang & Ho, 2005; Pan et al., 2011; Shu et al., 2006; Xue, Shu, Li, Li, & Tian, 2013). Unfortunately, this hypothesis has never been tested in Chinese.

Third, although there are a few longitudinal studies in Chinese, they mostly covered the developmental period from kindergarten to Grade 2 (e.g., Chow et al., 2005; Lei et al., 2011; McBride-Chang & Ho, 2005; Tong, McBride-Chang, Shu, & Wong, 2009). Pan and colleagues' (2011) and Song and colleagues' (in press) longitudinal studies covered a longer developmental period (from kindergarten