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## Modeling the relationship between rapid automatized naming and literacy skills across languages varying in orthographic consistency

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### ABSTRACT

The purpose of this study was twofold: (a) to contrast the prominent theoretical explanations of the rapid automatized naming (RAN)–reading relationship across languages varying in orthographic consistency (Chinese, English, and Finnish) and (b) to examine whether the same accounts can explain the RAN–spelling relationship. In total, 304 Grade 4 children (102 Chinese-speaking Taiwanese children, 117 English-speaking Canadian children, and 85 Finnish-speaking children) were assessed on measures of RAN, speed of processing, phonological processing, orthographic processing, reading fluency, and spelling. The results of path analysis indicated that RAN had a strong direct effect on reading fluency that was of the same size across languages and that only in English was a small proportion of its predictive variance mediated by orthographic processing. In contrast, RAN did not exert a significant direct effect on spelling, and a substantial proportion of its predictive variance was mediated by phonological processing (in Chinese and Finnish) and orthographic processing (in English). Given that RAN predicted reading fluency equally well across languages and that phonological/orthographic processing had very little to do with this relationship, we argue that the reason why RAN is related to reading fluency should be sought in domain-general factors such as serial processing and articulation.

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## Introduction

Rapid automatized naming (RAN), defined as the ability to name as fast as possible highly familiar visual stimuli such as digits, letters, colors, and objects, has been found to be a significant predictor of reading in every single language studied so far (Arabic: Taibah & Haynes, 2011; Chinese: Pan et al., 2011; Dutch: de Jong, 2011; German: Landerl & Wimmer, 2008; Greek: Georgiou, Parrila, Cui, & Papadopoulos, 2013; English: Bowers, 1995; Finnish: Lepola, Poskiparta, Laakkonen, & Niemi, 2005; Italian: Tobia & Marzocchi, 2014; Kannada: Nag & Snowling, 2012; Korean: Park & Uno, 2015; Norwegian: Lervåg & Hulme, 2009; Sinhala: Wijayathilake & Parrila, 2014). Despite the acknowledged importance of RAN in predicting reading, it remains unclear what mechanisms underlie the RAN–reading relationship and whether these mechanisms are the same across languages varying in orthographic consistency.<sup>1</sup> This is important in light of evidence showing that orthographic consistency moderates the RAN–reading relationship (e.g., Araújo, Reis, Petersson, & Faisca, 2015; Georgiou, Parrila, & Liao, 2008a). Arguably, if orthographic consistency moderates the relationship between RAN and reading, it may also influence the mechanisms underlying their relationship. Thus, the first goal of this study was to contrast the prominent theoretical accounts of the RAN–reading relationship across three languages that were selected to represent different points along the orthographic consistency continuum: Chinese, English, and Finnish.

Different theoretical accounts have been proposed to explain the relationship between RAN and reading (see Kirby, Georgiou, Martinussen, & Parrila, 2010, for a review). Initially, Torgesen, Wagner, and colleagues (Torgesen, Wagner, & Rashotte, 1994; Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997; Wagner & Torgesen, 1987) subsumed RAN under the phonological processing family, called it “phonological recoding in lexical access,” and proposed that it predicts reading because, just like reading, it requires access to and retrieval of phonological representations from long-term memory. More recently, Ziegler and colleagues (2010) argued that it is exactly because of its phonological component that RAN is able to predict reading, and when this phonological component is captured by sensitive enough measures of phonological awareness, RAN no longer predicts reading. Although the phonological processing account is still popular (see Bowey, McGuigan, & Ruschena, 2005; Savage, Pillay, & Melidona, 2007; Vaessen, Gerretsen, & Blomert, 2009; Ziegler et al., 2010), several studies have shown that RAN accounts for variance in reading over and above the effects of other measures of phonological processing such as phonological awareness (e.g., Lepola et al., 2005; Liao et al., 2015; Parrila, Kirby, & McQuarrie, 2004) and phonological short-term memory (e.g., Moll et al., 2014; Parrila et al., 2004; Xue, Shu, Li, Li, & Tian, 2013). In addition, individuals with both RAN and phonological awareness deficits experience the most severe reading difficulties (e.g., Kirby, Parrila, & Pfeiffer, 2003; McBride-Chang & Ho, 2000; Torppa, Georgiou, Salmi, Eklund, & Lyytinen, 2012), a finding suggesting that these two processing skills have independent and additive effects on reading.

In turn, Bowers and colleagues (e.g., Bowers, Sunseth, & Golden, 1999; Bowers & Wolf, 1993; Sunseth & Bowers, 2002) proposed that RAN is related to reading because of its connection to orthographic processing. If letter identification proceeds too slowly (indexed by slow naming speed), letter representations in words will not be activated quickly enough to induce sensitivity to commonly occurring orthographic patterns. In support of this hypothesis, researchers found that children with slow naming speed experience orthographic processing deficits (e.g., Bowers et al., 1999; Conrad & Levy, 2007; Powell, Stainthorp, & Stuart, 2014; Sunseth & Bowers, 2002). In addition, RAN has been found to be a stronger predictor of exception word reading (which presumably relies on good orthographic processing) than of nonword reading (which presumably relies on good phonological recoding) (e.g., Kruk, Mayer, & Funk, 2014; Manis, Seidenberg, & Doi, 1999). However, several studies have also shown that RAN continues to predict reading over and above the effects of orthographic processing (e.g., Georgiou, Parrila, & Kirby, 2009; Georgiou, Parrila, & Papadopoulos, 2008b; Liao, Georgiou, & Parrila, 2008). In addition, several studies have reported nonsignificant correlations between RAN

<sup>1</sup> This refers to phono-graphemic consistency.

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