Rapid Visual Processing by College Students in Reading Irregular Words and Phonologically Regular Pseudowords Presented Singly and in Contiguity

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Using normal adult readers, this study examined the relative involvement of magnocellular and parvocellular processes in reading English phonologically regular pseudowords and irregular words presented in isolation and in contiguity from left to right. The data showed that a low temporal frequency visual measure that implied more parvocellular involvement was active in processing irregular words presented singly and pseudowords presented in contiguity. However, the results failed to show the involvement of the magnocellular pathway (as implicated by low spatial and/or high temporal frequency visual measures) in reading words presented in contiguity from left to right. The discrepancy was discussed in terms of the sensitivity of the tasks used in testing the two pathways.

Key Words: College students, irregular words, normal readers, phonologically regular pseudowords, presentation format, rapid visual processing, word reading

Increasing evidence suggests that dyslexia may represent the lower end of an undemarcated continuum of reading ability, and is not distinct from normal reading with respect to some reading, cognitive, and temporal processes (Au & Lovegrove, 2001a; Conlon, Sanders, & Zapart, 2004). Thus, this study examined the role of rapid visual processing in reading among normal adults with respect to the magnocellular deficits hypothesis of dyslexia (Lovegrove, Martin, & Slaghuis, 1986; Stein & Talcott, 1999).

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According to the magnocellular deficits hypothesis (Stein & Talcott, 1999), dyslexics and language-impaired participants are impaired in processing rapidly presented stimuli (Borsting et al., 1996; Heath, Hogben, & Clark, 1999; Witton et al., 1998). These include poor detection of dynamic visual motion stimuli (Schulte-Körne, Deimel, Bartling, & Remschmidt, 2004; Solan, Hansen, Shelley-Tremblay, & Ficarra, 2003), visual temporal order judgment (TOJ) (Brannan & Williams, 1988; Cacace, McFarland, Quimby, Schrieber, & Marro, 2000), and gap detection (Boden & Brodeur, 1999; Chase & Jenner, 1993).

However, rapid sensory processes seem to be distal correlates rather than causes of the reading disorder, even though the temporal abilities account for a small amount of variance in subsequent language skills development (Chiappe, Stringer, Siegel, & Stanovich, 2002; Hood & Conlon, 2004; Lyytinen et al., 2005; Rose, Feldman, Jankowski, & Futterweit, 1999). In particular, the specific phonological deficit can occur with an optional concomitant sensorimotor syndrome (Ramus et al., 2003). Early temporal deficits do not necessarily cause deficits processing speech sounds, phonological or phoneme awareness (Bretherton & Holmes, 2003; Nittrouer, 1999; Studdert-Kennedy, 2002), and reading impairment (Laasonen, Service, & Virsu, 2002; Rosen, 2003; Share, Jorm, Maclean, & Matthews, 2002). Likewise, the reading deficits may stem from an independent deficiency in speech and nonspeech discriminative capacities rather than a general auditory perceptual deficit (Studdert-Kennedy & Mody, 1995) because significant differences are likely to be found in verbal as opposed to nonverbal stimuli (Boden & Brodeur, 1999; Breier, Gray, Fletcher, Foorman, & Klaas, 2002).

Given a lack of causal relationship between the magnocellular pathway and reading development, not all the disabled readers demonstrate temporal deficits. For instance, some poor readers do not show a loss of contrast sensitivity to low spatial frequency and/or high temporal frequency visual stimuli (Williams, Stuart, Castles, & McAnally, 2003), even though some of them do (Demb, Boynton, Best, & Heeger, 1997; Edwards et al., 2004). In terms of the psychophysical properties of the magnocellular (where dyslexics are poor at) and parvocellular pathways (where dyslexics have no deficits in), the former is more sensitive to low spatial and high temporal frequency visual stimuli, while the latter is more sensitive to high spatial and low temporal visual frequency stimuli (Baro, Garzia, & Lehmkuhle, 1996). The discrepancy of dyslexics having impaired magnocellular function or not in terms of their contrast sensitivity may be attributed to the use of the experimental conditions that are insensitive to the magnocellular pathway. Likewise, the parvocellular pathway can also be involved in contrast detection under such stimulus conditions (Skottun, 2000). For example, dyslexics are likely impaired in contrast detection in mesopic but not photopic luminance condition (Cornelissen, Richardson, Mason, Fowler, & Stein, 1995).

Interestingly, the visual magnocellular pathway is dominant in text reading (Chase, Ashourzadeh, Kelly, Monfette, & Kinsey, 2003) in