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Is the 'naming' deficit in dyslexia a misnomer?

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ABSTRACT

We report a study that investigated the widely held belief that naming-speed deficits in developmental dyslexia reflect impaired access to lexical-phonological codes. To investigate this issue, we compared adult dyslexic and adult non-dyslexic readers' performance when naming and semantically categorizing arrays of objects. Dyslexic readers yielded slower response latencies than non-dyslexic readers when naming objects, but a subsequent comparison of object-naming and object-categorization tasks showed that the apparent 'naming' deficit could be attributed to a more general difficulty in retrieving information – either phonological or semantic – from the visual stimulus. Our findings suggest that although visual–phonological connections may be crucial in explaining naming-speed performance they do not fully characterise dyslexic readers' naming-speed impairments.

1. Introduction

Developmental dyslexia is a term used to define individuals with lower reading ability than their developmental peers despite normal intelligence and adequate educational provision (Rutter & Yule, 1975). In the majority of cases, dyslexia is characterised by impaired (slower) reading fluency. Reading fluency deficits comprise arguably the most persistent deficits in dyslexia, affecting readers in transparent as well as opaque orthographies (Wimmer, Mayringer, & Landerl, 2000), and adult as well as child dyslexic readers (Bruck, 1998; Lefly & Pennington, 1991; Shaywitz, 2003). In this study, we use eye-tracking methodology to examine the validity of the widely held belief that dyslexics' fluency deficits stem from a specific deficit in retrieving and encoding phonological information associated with the lexical properties of a visually presented item.

1.1. Dyslexia and naming-speed

A great deal of evidence for reading fluency and naming-speed deficits in dyslexia has come from studies using *rapid automatized naming* (RAN) tasks (e.g., Denckla & Rudel, 1976a, 1976b). These tasks are designed to measure the speed with which a series of highly familiar items such as letters, digits, objects, and colors can be named. Naming-speed on these tasks is proposed to index the low-level factors involved in reading fluency, such as attention to the stimulus; bi-hemispheric visual processes responsible for feature detection; matching of feature and pattern encoding to stored orthographic representations; integration of visual with phonological information; and motor activation leading to articulation (Wolf & Bowers, 1999). Research shows that RAN exerts a unique and unidirectional influence on reading fluency (Bowers & Swanson, 1991; Lervåg & Hulme, 2009; Manis, Doi, & Badha, 2000; Parilla, Kirby, & McQuarrie, 2004; Powell, Stainthorp, Stuart, Garwood, & Quinlan, 2007; Wolf & Obregón, 1992), and children and adults with dyslexia are slower on RAN tasks compared with unimpaired, non-dyslexic readers (e.g., Denckla & Rudel, 1976a, 1976b; see Wolf and Bowers (1999) for a review). Despite the strong evidence for a relationship between RAN performance and fluency, however, we are currently some way from obtaining a complete understanding of the processes underpinning RAN speeds and dyslexic readers' slower performance on these tasks.

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Substantial evidence suggests that the ability to create and rapidly access well-specified phonological representations is important for normal reading development. Reading accuracy in particular is strongly related to an individual's conscious grasp of the phonemic properties of words (see Snowling, 2000). Similarly, reading fluency together with performance on RAN tasks have been characterised in terms of the speed with which phonological codes can be retrieved from the corresponding visual representation (Wagner & Torgesen, 1987; Wagner, Torgesen, Laughon, Simmons, & Rashotte, 1993; Wimmer et al., 2000). Confrontation naming studies also signal a phonological impairment: dyslexic readers are less accurate at naming pictures with longer rather than shorter names (Nation, Marshall, & Snowling, 2001; Swan & Goswami, 1997).

Despite this, a straightforward relationship between performance on speed of name retrieval and phonological ability is not found. In the case of RAN tasks, speed is found to predict reading measures such as fluency independently of phonological skill (Bowers, 1993; Powell et al., 2007), and is more closely associated with performance on tasks such as orthographic choice, word-likeness judgements and exception word reading than on tasks traditionally associated with explicit phonological skill, such as nonword reading (Manis, Seidenberg, & Doi, 1999). Manis et al. argued that RAN involves making arbitrary mappings of a visual stimulus to its name in a way that is similar to the partially arbitrary mappings that readers must make between an exception word, such as 'yacht' and its phonological properties. Thus, the visual–phonological mappings that participants must make in RAN are proposed to involve the same processes as accessing whole-word orthographic or lexical representations in reading (Wimmer, Mayringer, & Landerl, 1998). In a similar vein, Lervåg and Hulme (2009) recently proposed that RAN taps left-hemisphere object-recognition and naming circuits associated with the child's emerging visual word recognition system. Mid-fusiform regions, which have a role in uniquely identifying objects and words, form close connections with language regions responsible for name retrieval and semantic processing (Dehaene, 2005; Price et al., 2006). The efficiency of RAN performance and the visual word recognition system might therefore depend on the integrity of the mid-fusiform area and its connections with language regions associated with name retrieval (Lervåg & Hulme, 2009).

Current theorizing therefore emphasises visual–lexical connections as the common denominator in RAN and word reading. A critical challenge now is to pinpoint which aspects of this process result in slower naming for dyslexic readers, and whether phonological access, which has previously been identified as crucial in determining naming-speed, is the main impairment in dyslexics' naming-speed deficits. Indeed, there is a widely held belief that naming deficits in dyslexia reflect impaired access to phonological codes (e.g., Clarke, Hulme, & Snowling, 2005; Schatschneider, Carlson, Francis, Foorman, & Fletcher, 2002; Shankweiler & Crain, 1986; Stanovich, 1986; Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997; Wagner et al., 1993, Wagner & Torgesen, 1987), placing the deficit squarely in the phonological domain. This view has been challenged (cf. Wolf & Bowers, 1999), with alternative hypotheses proposing impairment; in the visual domain (e.g., Geiger, Lettvin, & Zegarra-Moran, 1992; Stein & Walsh, 1997) or in domain-general speed-of-processing (Kail & Hall, 1994; Kail, Hall, & Caskey, 1999). However, recent work suggests that these hypotheses may not be tenable (see Bonifacci & Snowling, 2008; Hawelka & Wimmer, 2005, 2008; Lervåg & Hulme, 2009). Ramus and Szenkovits (2008) recently put forward an alternative causal hypothesis in which impairments in dyslexia are reconceptualized as *access* impairments. Under this hypothesis, a deficit in executive function incurs access problems not only in phonological retrieval – thereby explaining the phonological deficits in dyslexia (e.g., Bradley & Bryant, 1983; de Jong & van der Leij, 2003; Hulme & Snowling, 1992; Ramus et al., 2003; Swan & Goswami, 1997) – but potentially also in other domains. In relation to naming deficits, access to representations may therefore be the critically impaired component – regardless of whether the dyslexic reader is required to access phonological information, or information from other (e.g., semantic) domains.

1.2. The current study

The main aim of our study is to examine whether naming deficits in dyslexia involve impairment in *naming,* that is, retrieval of specific lexical-phonological codes, or alternatively a more general impairment related to accessing and responding to information about the visual stimulus. Our method of investigation is to compare dyslexic and non-dyslexic readers' performance on tasks that either include or exclude a specific naming response. We therefore compared the same dyslexic and non-dyslexic participants' performance latencies when naming objects in an array (Fig. 1; Experiment 1, arrow *a*) with their performance when categorizing the same objects (Fig. 1; Experiment 2, arrow *b*). Whilst the naming task involves explicitly accessing, retrieving and phonologically encoding the stimulus' phonological properties, the categorization task requires accessing the stimulus' semantic and syntactic properties, and making a decision in response (Humphreys, Lamote, & Lloyd-Jones, 1995; Kroll & Potter, 1984; Lupker, 1988; Meyer, Sleiderink, & Levelt, 1998). Studies show that whilst concepts and lemmas (the grammatical and syntactic content of lexical entries) are continuously activated by a perceived stimulus, wordforms (the phonological content of lexical entries: in other words, object names) are activated only when the speaker's goal is to name the object (Altmann & Davidson, 2001; Bloem & La Heij, 2003; Levelt, Roelofs, & Meyer, 1999). Recent work qualifies this argument somewhat, with evidence suggesting that even during tasks in which the speaker does not intend to name an item, there is nevertheless some phonological activation (e.g., Meyer, Belke, Telling, & Humphreys, 2007). However, the extent of phonological activation under these circumstances is limited and attention dependent (Roelofs, 2008). We therefore assume that whilst naming involves explicit activation of phonological codes, categorization tasks involve little if any activation of phonological codes; we return to this issue in the general discussion.