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Grammatical language impairment and the specificity of cognitive domains: relations between auditory and language abilities

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Abstract

Grammatical-specific language impairment (G-SLI) in children, arguably, provides evidence for the existence of a specialised grammatical sub-system in the brain, necessary for normal language development. Some researchers challenge this, claiming that domain-general, low-level auditory deficits, particular to rapid processing, cause phonological deficits and thereby SLI. We investigate this possibility by testing the auditory discrimination abilities of G-SLI children for speech and non-speech sounds, at varying presentation rates, and controlling for the effects of age and language on performance. For non-speech formant transitions, 69% of the G-SLI children showed normal auditory processing, whereas for the same acoustic information in speech, only 31% did so. For rapidly presented tones, 46% of the G-SLI children performed normally. Auditory performance with speech and non-speech sounds differentiated the G-SLI children from their age-matched controls, whereas speed of processing did not. The G-SLI children evinced no relationship between their auditory and phonological/grammatical abilities. We found no consistent evidence that a deficit in processing rapid acoustic information causes or maintains G-SLI. The findings, from at least those G-SLI children who do not exhibit any auditory deficits, provide further evidence supporting the existence of a primary domain-specific deficit underlying G-SLI.

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1. Introduction

An ongoing enquiry in cognitive science concerns the role of genes and environmental experience in shaping the development of specialised cognitive abilities. Most people acknowledge that both genes and environment are important in developing specialised systems. However, some researchers argue that domain-specific cognitive abilities develop from (genetically) pre-determined specialised mechanisms or neural circuitry (Chomsky, 1986; Pinker, 1994, 2002). Alternatively, others claim that specialised systems develop from more general-purpose mechanisms, becoming specialised through experience (Bates, 1993; Elman et al., 1996; Karmiloff-Smith, 1998). Importantly, according to Karmiloff-Smith and colleagues, there is unlikely to be pre-determination of mechanism (and, we presume, of neural circuitry) unique to a specialised ability and, therefore, pure primary impairments of specialised systems should not exist (Karmiloff-Smith, 1998; Thomas & Karmiloff-Smith, 2002). Moreover, Thomas and Karmiloff-Smith claim that there is no evidence for “residual normality” alongside any developmental deficit. Thus, this debate concerns basic questions about the development, structure and function of the brain.

The domain-specific perspective of cognitive abilities would be supported by the existence of developmental domain-specific deficits. Such evidence is, arguably, provided by “Grammatical-Specific Language Impairment” (G-SLI) (van der Lely, Rosen, & McClelland, 1998). SLI is a genetic deficit (Lai, Fisher, Hurst, Vargha-Khadem, & Monaco, 2001; SLI Consortium, 2002), heterogeneously affecting language acquisition in around 7% of children, who are otherwise apparently developing normally (Leonard, 1998). G-SLI children are a sub-group of the SLI population (van der Lely, 1996, 1998). Following extensive investigations of grammatical, non-grammatical language and non-verbal abilities, van der Lely and colleagues (e.g. Marshall, Harris, & van der Lely, 2003; van der Lely & Battell, 2003; van der Lely & Christian, 2000; van der Lely et al., 1998; van der Lely & Ullman, 2001) claim that G-SLI children have a relatively pure developmental domain-specific deficit in the grammatical aspects of language (syntax, morphology, and phonology) that are core to the human language faculty (Chomsky, 1995). Note that, although the grammatical deficit causes predictable secondary problems with word learning and therefore vocabulary knowledge (van der Lely, 1994; van der Lely, & Froud, 2002), this is, nonetheless, consistent with a domain-specific deficit (van der Lely, 2004). The grammatical impairments found in English speaking G-SLI children are supported by recent studies in other laboratories (Bishop, Bright, James, Bishop, & van der Lely, 2000), and cross-linguistic investigations in Greek and Hebrew-speaking G-SLI children (Friedmann & Novogrodsky, 2002, in press; Stavrakaki, 2001, 2002).

However, the grammatical specificity of the deficit in G-SLI has been challenged by researchers who suggest that G-SLI is caused by an auditory processing deficit which derives from a more general processing deficit, and is clearly outside the language system (Elman et al., 1996; Joanisse & Seidenberg, 1998; Karmiloff & Karmiloff-Smith, 2001; McClelland & Patterson, 2002; Tallal et al., 1996; Tomblin & Pandich, 1999). From this domain-general perspective, the link between auditory and grammatical deficits is as follows: In line with assumptions that experience determines the development of specialisation, a general deficit in processing speed, affecting auditory processing, causes

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