

# Testing theories of developmental dyscalculia

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Developmental dyscalculia (DD) is a learning difficulty thought to be specific to mathematics. Currently dominant cognitive neuroscience theories of DD suggest that DD originates from the impairment of the magnitude representation (MR) of the human brain, residing in the interparietal sulcus (IPS), or from impaired connections between number symbols and the MR. However, behavioural research offers several alternative theories for DD and neuroimaging also suggests that impairments in DD may be linked to disruptions of other functions of the IPS than the MR. That is, besides the MR, impairment of working memory, attention, inhibition and spatial processing were also proposed to underlie DD. Strikingly, the MR theory has never been explicitly contrasted with the range of alternatives in a systematic fashion. Here we have filled this gap by recording an extremely detailed profile of DD and directly contrasting five alternative theories of DD in 9-10 year-old primary school children. We used both behavioural and neuro-imaging tasks and used practically all available measures of the MR. Participants were carefully filtered from a pool of 1004 children and took part in 15 standardized tests and 9 experiments. DD and control participants were completely matched on reading skills, verbal and non-verbal IQ, general processing speed and socio-economic status. None of the results supported the MR theory of DD. In contrast, various domain general functions emerged as strong markers of impaired function in DD. The theoretical and practical significance of findings will be discussed.