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Evidence from cognitive neuroscience for the role of graphical and algebraic representations in understanding function.

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Summary: Using traditional educational research methods, it is difficult to assess students' understanding of mathematical concepts, even though qualitative methods such as task observation and interviews provide some useful information. It has now become possible to use functional magnetic resonance imaging (fMRI) to observe brain activity whilst students think about mathematics, although much of this work has concentrated on number. In this study, we used fMRI to examine brain activity whilst ten university students translated between graphical and algebraic formats of both linear and quadratic mathematical functions. Consistent with previous studies on the representation of number, this task elicited activity in the intra-parietal sulcus, as well as in the inferior frontal gyrus. We also analysed qualitative data on participants' introspection of strategies employed when reasoning about function. Expert participants focused more on key properties of functions when translating between formats than did novices. Implications for the teaching and learning of functions are discussed, including the relationship of function properties to difficulties in conversion from algebraic to graphical representation systems and vice versa, the desirability of teachers focusing attention on function properties, and the importance of integrating graphical and algebraic function instruction.

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