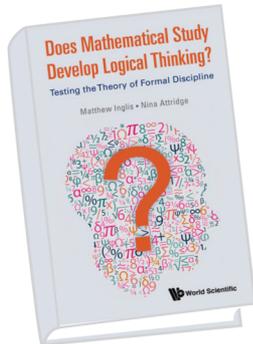




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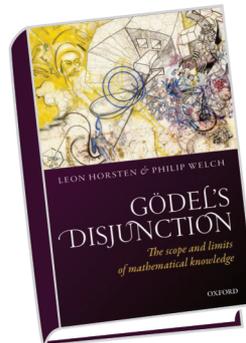


Does Mathematical Study Develop Logical Thinking?: Testing the Theory of Formal Discipline, by Matthew Inglis and Nina Atttridge (World Scientific, February 2017).

One reason mathematics occupies such a central position in education is the widespread belief that studying mathematics doesn't just endow students with skills specific to the subject. It also helps them develop general abilities to think and reason logically. This belief, called the "Theory of Formal Discipline (TFD)," was for a long time invoked to justify teaching Latin, which was also thought to develop general brainpower. But does the TFD really stand up to scrutiny? This is the question this book sets out to explore. The authors point out that, during the 20th century, a large body of research in educational psychology has concluded that the TFD is "largely false." This has led to a "strange situation" regarding the TFD: "large numbers of mathematics graduates and mathematicians are apparently convinced that studying mathematics develops the general thinking skills of logical reasoning and problem solving, but throughout most of the twentieth century psychologists were apparently convinced that this could not be the case." The authors present a series of studies that attempt to resolve this conundrum. They find that while the TFD is consistent with the results of their studies, the picture is more complex than commonly assumed. In particular, the results are sometimes better explained by what they call the "filtering hypothesis." This hypothesis says that study of mathematics acts as a filter that retains students who are good at logical reasoning. In other words, it's exactly those students with good logical reasoning skills who persist in taking math beyond the required courses; their superior skills are then chalked up to all the math they have taken. Trying to carefully tease out the various factors at play, the authors offer a nuanced picture of the reliability and limitations of the TFD.

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Gödel's Disjunction: The Scope and Limits of Mathematical Knowledge, edited by Leon Horsten and Philip Welch (Oxford University Press, August 2016).

"I want to start by quarrelling with Sir Roger Penrose." These words appear in a 2003 paper by Oxford philosopher John Lucas, whose lively and longstanding debate with Roger Penrose drew in many thinkers from philosophy, mathematics, physics, and other subjects. The nub of the debate is the topic of this book, namely, Gödel's disjunction, which Kurt Gödel stated in his Gibbs Lecture, presented at an AMS meeting in December 1951 in Providence, RI. The lecture initially went unpublished but eventually appeared in 1995 in a collection of his work edited by Solomon Feferman. Here is Gödel's disjunction, in Gödel's own words: "Either ... the human mind ... infinitely surpasses the powers of any finite machine, or else there exist absolutely unsolvable diophantine problems." The introduction of *Gödel's Disjunction* provides this alternate statement: "Either the human mind cannot be captured by an algorithm, or there exist absolutely undecidable propositions." Gödel asserted in the Gibbs lecture that this disjunction is a "mathematically established fact." But, as Peter Koellner asks in the paper he contributed to this volume: "Which is it? Is it the case that the mind cannot be mechanized? Or is it the case that mathematical truth outstrips human reason? Or is it perhaps both?" These are the questions that inspired not only the Lucas-Penrose debate but a great deal of scholarly thought. *Gödel's Disjunction* contains papers that grew out of two workshops held in 2012 and 2013 at the University of Bristol, in which participants sought to develop insights into the two disjuncts and, as the introduction states, "to come closer to deciding the truth value of either of them." Interestingly, Gödel accepted as true the first disjunct—the mind is not like a machine—and he hoped to refute the second disjunct that there exist absolutely undecidable propositions. Emil Post, who independently thought about such matters in the 1920s, took the opposite view. As Graham Leach-Krouse writes in his contribution to the volume, "Post, on the basis of a rejection of [the first disjunct], apparently hoped to prove [the second]." Containing essays at a range of technical levels, this thought-provoking volume holds appeal for experts as well as more-general readers.