

Book Reviews

Gilmore, Camilla, Göbel, Silke M., & Inglis, Matthew (2018). *An Introduction to Mathematical Cognition*. Abingdon, United Kingdom: Routledge. 248 pp. ISBN 9781138923959.

Book Review of “An Introduction to Mathematical Cognition” by C. Gilmore, S. M. Göbel, and M. Inglis

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I don't expect a textbook to be page-turner, but this one is just that, at least for a reader who has failed to keep up with the proliferating literature, and welcomes an injection of scholarship. I found this volume to be scrupulous in detail, strong in organization, and, perhaps most valuable, non-partisan in its approach.

The first seven chapters cover the areas most of us would expect to find in a developmental psychologist's account of the field. But there is joy in discovering the careful construction of the narrative, and the thoughtful selection of those studies to be reported more fully. There is a genuine sense of narrative here, of an unfolding story. At the outset, the potentially daunting topic of non-symbolic number is examined in some detail, and contextualized, with careful attention given to the literature on subitizing. I shared this section with a Masters-level student who found it particularly informative, providing a coherent background to what can seem a profusion of contradictory evidence. The final statement is refreshingly honest: 'Currently it looks like the debates about whether there is an ANS, and, if it exists, how it is relates to mathematical development are far from over' (p. 27).

Similarly, the research work that has flowed so generously from Karen Wynn's Give-a-Number task is nicely assimilated alongside the 'principles vs. practice debate'. Here, and throughout the book, it is rewarding to find that the reader is presented with an authoritative and articulate account of the different interpretations of findings, and allowed to form their own opinion. I did miss reference to Karen Fuson in the section on number word acquisition- but you can't have everything- and I enjoyed the cross-linguistic comparisons. The treatment of the development of Arabic numeral knowledge is wide-ranging, mentions Moyer and Landauer

(could perhaps have highlighted more clearly their seminal contribution), includes a useful account of neural correlates, and leads to a nicely expanded treatment of transcoding.

I wonder if I'm alone in thinking that the attempts of researchers to understand the development of children's arithmetic skills have been less fruitful, perhaps less ambitious, than the work on symbolic and non-symbolic number? The authors do an excellent job of compiling the key areas studied. The classification of arithmetic word problems, for example, is nicely laid out. But one might ask, where has this taken us? Are there linguistic and logical constraints operating on number word problems? Are the mental models of non-verbal arithmetic no longer relevant? Is there no more to be said, or asked? It is perhaps the complexity of the developmental process, the numerous domain-general and educational influences, which make it difficult to produce any truly comprehensive theory. Looking further into arithmetic concepts, there seems to be more promise. The authors identify additive composition as a particular area of interest. The examination of commutativity, associativity and inversion sets up some engaging potential interactions with studies of algebra and reasoning later in the book.

Moving to developmental difficulties in mathematics, and particularly dyscalculia, the authors again provide an authoritative and balanced review of the literature, allowing the research evidence to speak for itself. Again, there is a valuable account of neuroscientific findings. The uncertainties about causation are made clear. A final section on math anxiety reveals the strength of research in this area, the important effects on children's lives, and also the promising interventions which are being undertaken.

From Chapter 8, Number Systems, to the conclusion of the volume, the territory changes. The higher level topics of algebra, reasoning and mathematical proof take us beyond the widely studied areas of arithmetic and its precursors. There's an excitement here, and a welcome acknowledgment that readers may need some introductory text to open up each of the new topics. I learned a lot, and I'm grateful. Here, at last, albeit fleetingly, the name of Piaget is mentioned, if only to expose the weakness of his claims. A number of points are of particular interest. I was enthused by the comparative studies which show the differences between Western and Asian children's concepts of equivalence, possibly accounted for by early unremitting exposure to canonical arithmetic sentences on the one hand, or to varying representations of equivalence on the other. The account of research into children's understanding of mathematical proof, the examination of theories of conceptual change, or resistance to change, and the studies exploring the Theory of Formal Discipline (the proposal that mathematical learning enhances general reasoning) are all fascinating. To me they extend the scope of research ambition in a way that is encouraging for the future. The final call to arms, to address the replication crisis, and to set a comprehensive and shared research agenda for the field, is similarly encouraging.

Does the book succeed in the goal of interdisciplinarity which it sets for the field? Readers will decide. I believe the early chapters' concentration on psychological research findings is necessary. I enjoyed the references to studies of educational interventions, and the tempting offering of an account of the development of conceptual understanding (in relation to equivalence) that entails variation in educational inputs.

The joint authorship of the book is, in my view, a great success. While identifying individual areas of expertise I found no disjunction or inconsistency of style. If anything was lacking for me it would be an examination of the overarching models. LeFevre's Pathways model and Dehaene's Triple Code Model, which is now being cited by developmentalists, deserve careful consideration. If I could personally commission another chapter it would be one devoted to conceptual development *per se*, a place where Piaget's absence is explained, his

successors (Case, Carey, others) are interrogated and the authors offer their own opinions. Perhaps that will be included in the next edition, or the next book. Gilmore, Goebel and Inglis have left me both satisfied and wanting more.

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