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Towards a more comprehensive model of children's number sense

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Given that the conference is linked with the theme of the CERME-TWG on early years mathematics, the major goal of this plenary talk is to critically discuss the state-of-the-art in the research domain of early numerical development. We start with a brief review of the highly influential and successful (neuro)cognitive research in this domain - which is heavily focused on the development of children's (non-symbolic and symbolic) magnitude representation and strongly dominated by the theory of the approximate number system (ANS) – as well as the intervention studies that it has elicited. This narrow focus on only these early numerical abilities can be questioned. For instance, recent meta-analyses have shown that children's (non-symbolic) numerical magnitude processing abilities explain only a (very) small percentage of the individual differences in general mathematics achievement, suggesting that other variables contribute more substantially to the acquisition of numerical competence and general mathematical proficiency. Therefore, we will confront and complement this (neuro)cognitive approach with three other lines of research – which typically have greater affinity with the research field of mathematics education - that may help to develop a more comprehensive picture of the development of children's number sense and how it relates to their later mathematical proficiency. First, while most (neuro)cognitive studies on the development of numerical abilities, particularly those related to ANS-theory, have almost entirely focused on the cardinal aspect of the number system, researchers start to pay more attention to the ordinal aspect of number. A second aspect that has been neglected in most (neuro)cognitive research on early numerical development is children's acquisition of mathematical pattern and structure (P&S) competence. Starting from the view of mathematics as "a science of patterns and structures", researchers are starting to integrate P&S into their theoretical models and their empirical studies. Third, while most (neuro)cognitive studies focus on the ability component of early numerical development, researchers nowadays also start to look at dispositional aspects, such as the extent to which children spontaneously attend to or focus on numbers and on P&S in their environment, and how these tendencies can be enhanced through education.

*This plenary talk will be co-authored with Joke Torbeyns and Bert De Smedt, University of Leuven, Belgium.