The University of Hong Kong
Department of Psychology
Departmental Seminar

The Roles of the Approximate Number System and Number-numerosity Mapping on the Mathematics Achievement in Normally- and Low-achieving Children and Children with Mathematics Learning Disability

Date: August 28, 2014 (Thursday)
Time: 12:00 noon – 1:00 p.m.
Venue: Room 813, 8/F, The Jockey Club Tower, Centennial Campus, HKU

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Humans are born with a basic sense of number. This number sense, which is now called the Approximate Number System (ANS), allows us to represent numerosity without the use of symbols. There has been a debate on whether this nonsymbolic ANS contributes to our symbolic mathematics skills, and the recent findings are inclined to support the link between the two. However, what remains unclear is the mechanism underlying the relationship between the ANS and our mathematics skills, and whether children with Mathematics Learning Disabilities (MLD) suffer from a defective ANS. The present presentation aimed at addressing the above issues in two studies. Study 1 aimed at identifying the mechanism of how the ANS contributes to children's mathematics skills. A group of 210 kindergarteners were tested on their ANS acuity, number-numerosity mapping skills (measured by counting and estimation tasks), and their arithmetic skills. They were then re-tested twice when they were in Grade 1. Using Structural Equation Modeling, it was found that children's ANS acuity in kindergarten

predicted their arithmetic skills one year later, and the relationship was mediated by their number-numerosity mapping skills. This suggested that ANS may contribute to mathematics learning by enabling more precise mapping between number symbols and the corresponding numerosity representation, hence making numbers meaningful. Studies 2A and 2B aimed at verifying whether children with MLD suffered from deficits in their ANS as well as their number-numerosity mapping skills. The same group of participants was followed one more time in Grade 2. Using the standard low-achievement method (Study 2A) and a more data-driven method known as the latent class growth analysis (Study 2B), two groups of children with MLD were identified. Both groups of children had deficits in both the ANS and their number-numerosity mapping skills as compared with their normally-achieving peers. Other groups of low-achieving children were also identified, and their difficulties seemed to be contributed by factors other than their ANS. While one of the low-achieving groups seemed to have deficit lying mainly on the number-numerosity mapping skills, the other low-achieving group did not show any cognitive deficits but had much lower SES compared to other groups. The relationship between the ANS and children's mathematics achievement was supported and elaborated in the present study. The findings not only articulated a potential mechanism of how children learned about mathematics, but they also allowed educators to have better understanding of the cognitive profiles of children with MLD, thus facilitating early identification and intervention. The different profiles of the low-achieving groups also highlighted the need for differential intervention for different groups of low-achieving children.