UNIVERSITÄT SALZBURG

Fachbereich Psychologie & Salzburger Gesellschaft für Psychologie
Kolloquiumsreihe

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Genetic and Environmental effects on Mathematical Ability and Disability: the latest Quantitative and Molecular genetic results from the TEDS study

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I will present the latest research from the Twins' Early Development study (TEDS) that involves 10,000 pairs of UK twins. The study aims to provide a systematic longitudinal investigation of individual differences in different aspects of mathematical ability and the links between mathematics, reading, language, and spatial abilities. The quantitative genetic results support the 'generalist genes' hypothesis that mostly the same genes contribute to the individual differences in diverse aspects of mathematics and that most of the genes that contribute to individual differences in mathematics are the same genes that affect reading and general cognitive ability. However, some genetic specificity also exists. Our research also suggests another way in which genes for mathematical ability are generalists: we find strong genetic links between normal and abnormal. In other words, the same genes are largely involved in both normal variation and low mathematical performance. In addition to the quantitative genetic findings, I will describe our on-going molecular genetic investigation, which is a multi-stage whole-genome association study designed to find 'generalist' and 'specialist' DNA polymorphisms associated with individual differences in mathematical ability. Our recently conducted genomewide association scan identified first quantitative trait loci (QTLs) together explaining 3% in general mathematical ability ($p = 7.277e-14$). The association is linear across the distribution consistent with a quantitative trait locus (QTL) hypothesis; the third of children in our sample who harbor 10 or more of the 20 risk alleles are nearly twice as likely to be in the lowest performing 15% of the distribution. I will also describe our on-going behavioral genomic investigations that specifically test the generalist genes hypothesis by examining the effects of these polymorphisms on different areas of cognition and achievement assessed longitudinally in TEDS. I will then present the results of our fMRI study comparing the brain correlates of the non-symbolic numerosity processing in children with high and low mathematical ability. Final-

ly, I will introduce our current research into the etiological relationship between individual differences in numerical abilities and mathematical achievement. It is our hope that this research will ultimately lead to better classification and treatment of common learning disabilities as well as developing new curricula and educational methods.