RELATION BETWEEN APPROXIMATE NUMBER SYSTEM ACUITY AND MATHEMATICAL ACHIEVEMENT: THE INFLUENCE OF FLUENCY

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Previous studies have observed inconsistent relations between the acuity of the Approximate Number System (ANS) and mathematical achievement. In this paper, we hypothesize that the relation between ANS acuity and mathematical achievement is influenced by fluency; that is, the mathematical achievement test covering a greater expanse of mathematical fluency may better reflect the relation between ANS acuity and mathematics skills. We explored three types of mathematical achievement tests utilized in this study: Subtraction, graded, and semester-final examination. The subtraction test was designed to measure the mathematical fluency.

Methods

Participants： A total of 219 participants (128 males, 91 females, mean age = 11.5, SD = 0.6) were recruited from the fifth grade of primary schools in the Xinjiang autonomous region, P.R. of China. All participants were taught math in Mandarin. They had normal or corrected-to-normal vision.

Data analyses： Inter-correlation analyses were first conducted on all measures. Then, a series of hierarchy regression analyses were performed to test the role of the ANS and figure matching in math achievement and subtraction, after controlling for age, gender, and other general cognitive processes. We also used a path model to test structural relationships between all measures in the current study. The path analysis was performed with the IBM SPSS Amos 20 software using maximum likelihood estimation.

Results

The current study showed that the relation between ANS acuity and mathematical achievement was influenced by fluency. Firstly, we replicated the previous finding on the relation between the ANS acuity and math fluency (Halberda et al., 2008; Zhang et al., 2016; Zhou & Cheng, 2015). We further found that graded mathematical achievement but not semester-final examination was still significantly correlated with numerosity comparison when controlling for age, gender and general cognitive processes (choice reaction time, mental rotation, nonverbal matrix reasoning). Furthermore, the variance of graded mathematical achievement contributed by numerosity comparison can be interpreted by visual form perception. These results confirm our expectations.

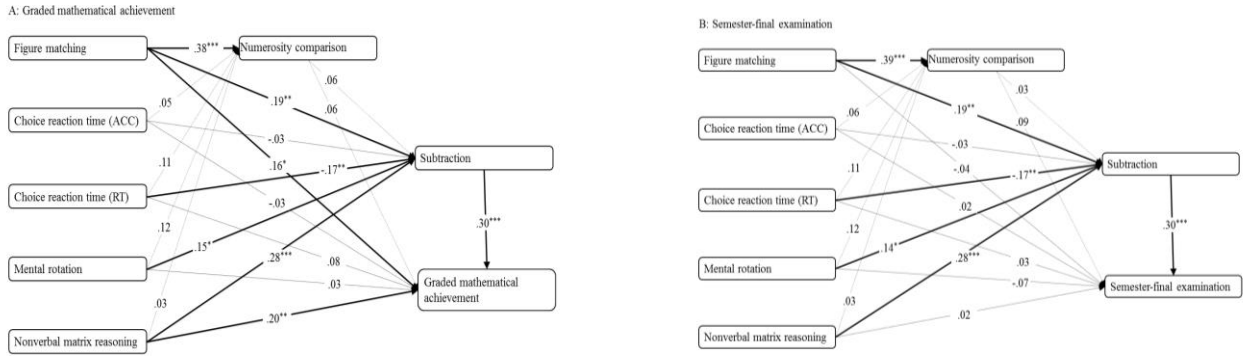

Figure 1: Path model for the relation of general cognitive processes and math achievement.

References

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