GENERAL MENTAL ABILITY PREDICTING ACHIEVEMENT IN MATHEMATICS

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INTRODUCTION

Success in school plays an important role in impacting students' future opportunities, making some choices more likely and eliminating others. The acquisition and application of mathematics skills, such as counting and simple addition and subtraction, hold great societal importance due to the demands of formal schooling, daily living activities, and employment.

The present study demonstrates that achieving and underachieving students in mathematics differ significantly at their levels of psychometrically measured mental abilities during adolescence.

METHOD

PARTICIPANTS

The sample consisted of 969 adolescents (60% females, 40% males) attending grades 7th to 12th. The students' age ranged from 13 to 18, with a mean age of 16.4 years (SD = 1.62). The sample was drawn from 10 Estonian-speaking public secondary schools and gymnasiums from different regions of Estonia in 2010. Written consent was obtained from adolescents' parents.

MEASURES

▪ Mental abilities

General intelligence was measured by the **Mental Abilities Scale for Students** (*ÕP-VVS*) developed by Tripod. The scale consisted of four subscales: verbal, numerical, visuo-spatial abilities and logical thinking, consisting of 50, 25, 30, and 25 questions, respectively. The items are gradually increasing in difficulty, therefore, the test can be used in a wide age range. The scale was administered online and time-limit to answer was 8 minutes for each subtest.

The scale had good psychometric properties and all subscales' scores were distributed similarly to normal curve. The internal reliability of the total scale was α = .90 for this sample.

▪ Mathematical achievement

Students reported their grades in Literature, History, Physics, and Mathematics in the previous school year. Self-reported grades are known to be valid because of their strong correlation with grades taken from school records (Kuncel, Crede, & Thomas, 2005).

In this study, only grades of **Mathematics** (MATH) were used for 629 students. The knowledge, skills and proficiencies of students are graded using a five-mark system in Estonia, where a mark of 5 is "very good" (n = 156), 4 is "good" (n = 272) and 3 is "satisfactory" (n = 201).

RESULTS

The main results of the study were as follows:

(1) There was a remarkable cross-sectional growth of intelligence during adolescence, $F(5,690)$ = 35.2, $p < .001$. The average normative increase was 4.2 (SD = 1.69) raw points in the total score per year between ages 13 to 18;

(2) Spearman rank order correlation between the total score and MATH was .26 ($p < .001$), indicating that better knowledge in mathematics at school is supported by higher level of general intelligence;

(3) The mean levels of total scores differed statistically significantly ($p < .001$) between high and low academic achievement groups in all ages, $F(2,626)$ = 23.2, $p < .001$ (for total sample). The average level of mental abilities was representative of students with average mathematical achievement. Across all age groups, successful students in MATH performed above average in mental abilities test. Contrarily, students with low academic achievement in MATH obtained below the average intelligence scores.

(4) There was no interaction between students' age and MATH grade, $F(11, 610)$ = .72, p = .72; age was used as a covariate (see *Figure 1*).

FIGURE 1. STUDENTS' AGE AND MATHEMATICAL ACHIEVEMENT PREDICTING GENERAL MENTAL ABILITY.
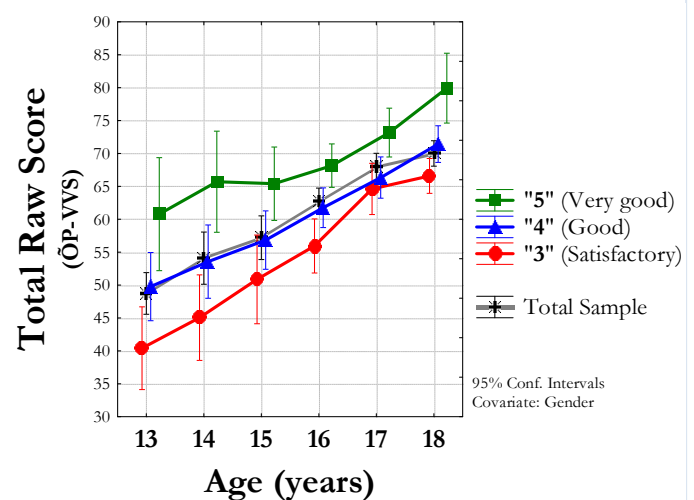
REFERENCE

Kuncel, N. R., Crede, M., & Thomas, L. L. (2005). The validity of self-reported grade point averages, class ranks, and test scores: A meta-analysis and review of the literature. *Review of Educational Research, 75*, 63–82.

CONCLUSION

Individual differences in general mental ability indicate differences in mathematical achievement at school. Higher cognitive ability refers to a potential to outperform average students in mathematics.

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