The Importance of Motivation as Predictor of Mathematical Competence in PISA 2003 and 2004

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Introduction

- Different motivational concepts predict school grades over and beyond intelligence and prior achievement (Chamorro-Premuzic et al., 2010; Freudenthaler et al., 2008; Gottfried, 1990; Schicke & Fagan, 1994; Spinath et al., 2006; Steinmayr et al., 2011; Steinmayr & Spinath, 2009; Steinmayr & Meißner, 2013).
- Yet, little is known about the incremental power of different motivational concepts predicting standardized achievement (cross-sectionally as well as longitudinally).
  - Previous research has just shown that ability self-perceptions (Gose et al., 1980; Schicke & Fagan, 1994; Steinmayr & Meißner, 2013; Trautwein et al., 2012) and intrinsic motivation (Gottfried, 1985; Lloyd & Barenblatt, 1984; Murayama et al., 2013) predict standardized achievement over intelligence (even though intelligence remained the strongest predictor).
- The aim of our study is to examine the extent to which different motivational concepts contribute to the prediction of mathematical competence in PISA beyond intelligence and prior achievement.

Thus, it was hypothesized that:

1. The examined motivational constructs incrementally predict standardized achievement in math beyond intelligence (cross-sectional).
2. Cross-sectionally, intelligence is the strongest predictor of the mathematical competence followed by the self-efficacy and ability self-perceptions.
3. Longitudinally, prior achievement is the strongest predictor of the mathematical competence followed by intelligence and self-efficacy.
4. When predicting standardized achievement longitudinally, motivational constructs and intelligence will still explain additional variance beyond prior achievement.

Methods

- One-year longitudinal approach on the basis of PISA 2003 and 2004
- 6.020 fifteen-year-old German students
  - Gender: 55.4% female, 44.6% male
  - School type: 42.6% Gymnasium, 10.6% Integrated School, 35.1% Realschule, and 11.7% schools with multiple courses of education
- **Intelligence**. Cognitive Abilities Test 5-12+R (Heller et al., 1976)
- **Motivation.** Participants self-reported (math-specific)
  - **Ability self-perception:** how good students thought they were at different activities in math
  - **Self-efficacy (task-specific):** how well students thought they could solve different specific tasks in math
  - **Self-efficacy (global):** how convinced students were that they perform well in math
  - **Interest:** how interested students are in math
  - **Enjoyment:** how much students like and have fun in math
  - **Instrumental motivation:** how students perceived usefulness of what they learned in math
  - **Goal orientations:** learning goals, performance-approach and performance-avoidance goals, work avoidance
- **Standardized Achievement / Mathematical competence**. Standardized mathematics achievement test from the PISA-study.

Results

Figure 1: Path diagram for the cross-sectional prediction of the mathematical competence

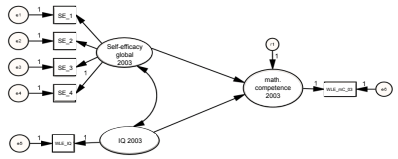


Figure 2: Relative weights analysis (cross-sectional)

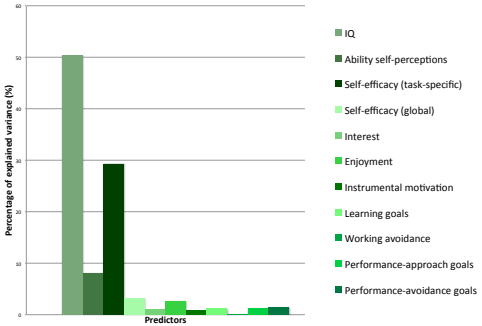


Figure 3: Path diagram for the longitudinal prediction of the mathematical competence

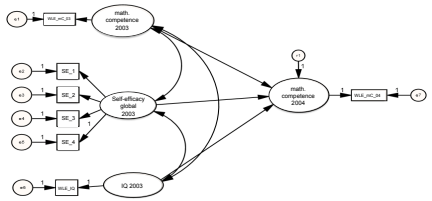
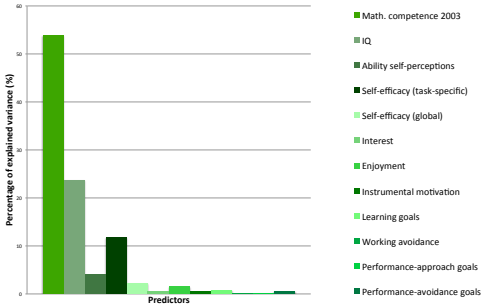


Figure 4: Relative weights analysis (longitudinal)



Discussion / Conclusions

- Cross-sectionally, all motivational constructs incrementally contributed to the prediction of mathematical competence beyond intelligence.
  - The Relative weights analysis showed that intelligence explained most of the variance in mathematical competence.
  - The Relative weights analyses showed as well that self-efficacy (international) explained more unique variance in mathematical competence than the other examined motivational constructs.
- After controlling for intelligence and prior achievement, self-efficacy, self-concept, interest, enjoyment, and learning goals still significantly predicted subsequent mathematical competence.
  - The Relative weights analysis showed that prior achievement explained most of the variance in mathematical competence followed by intelligence.
  - With regard to the motivational concepts, self-efficacy (international) was the strongest predictor again.
- These results confirm that motivation plays an important role when predicting academic achievement.
- Teachers should concentrate on enhancing these motivational constructs in order to improve the achievement of their students.

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