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Testing the internal/external frame of reference model of academic achievement and academic self-concept with open self-concept reports

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ABSTRACT

The internal/external frame of reference model (I/E model) describes the relations between math and verbal achievement and self-concept. Whereas math and verbal achievement are positively associated with the corresponding self-concept, they are negatively associated with the non-corresponding self-concept. As yet, investigations of the I/E model have concentrated on quantitative self-concept assessments in closed-ended questionnaires. The present study aims to investigate whether the patterns of the I/E model are replicated when open-ended self-concept measures are used. Assessing open as well as closed self-concepts of $N = 471$ German high school students provides evidence for the generalizability of the I/E model to open-ended self-concept assessments: We found the typical I/E model patterns with both open and closed self-concepts.

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1. Introduction

Academic self-concept has stimulated extensive research in educational psychology. A positive academic self-concept is not only a highly desirable goal in school and education, but also an important predictor of various educational outcomes (Marsh, 2007). For example, academic self-concept predicts academic motivation (Guay, Ratelle, Roy, & Litalien, 2010), academic attainment (Guay, Larose, & Boivin, 2004; Möller, Retelsdorf, Köller, & Marsh, 2011), and educational choice behaviors such as university entry and course selection (Parker, Marsh, Ciarrochi, Marshall, & Abduljabbar, 2014; Parker et al., 2012). The reciprocal relation between academic self-concept and academic achievement over time has been well documented (e.g., Chen, Yeh, Hwang, & Lin, 2013; Marsh & Köller, 2004; Möller, Zimmermann, & Köller, 2014; Niepel, Brunner, & Preckel, 2014; Parker, Marsh, Lüdtke, & Trautwein, 2013; Retelsdorf, Köller, & Möller, 2014). Thus, as academic self-concept plays a major role in students' achievement and achievement aspirations, it is useful to understand the mechanisms involved in academic self-concept formation.

Two of these mechanisms are described in one of the most prominent models in educational self-concept research, the internal/external frame of reference model (I/E model; Marsh, 1986). The I/E model and its more recent extension into dimensional comparison theory (Möller & Marsh, 2013) describes the formation of academic self-concept as dependent on the simultaneous operation of social and dimensional comparison processes. On the one hand, students compare their performance in a certain school subject with the performance of other students in the same school subject (*social comparison*). On the other hand, students compare their performance in a school subject with their performance in other school subjects (*dimensional comparison*). Hence, an academic self-concept in a particular school subject is assumed to be formed in relation both to an external frame of reference (i.e., social comparison) and to an internal frame of reference (i.e., dimensional comparison). Although a student might, for example, only show average math achievement in relation to his or her classmates, they may still have a favorable math self-concept because they are better in math than in English.

The I/E model provides an explanation for the seemingly paradoxical finding (e.g., Marsh & Hau, 2004; Marsh et al., 2015) that math and verbal self-concepts are almost uncorrelated, although achievement in math is substantially correlated to that in the verbal domain. According to the assumed social comparison process, good

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math achievement is associated with a higher math self-concept and good verbal achievement is associated with a higher verbal self-concept. Moreover, due to the assumed dimensional comparison process, good math achievement is associated with a lower verbal self-concept (controlling for the positive relation between verbal achievement and verbal self-concept) and good verbal achievement is associated with a lower math self-concept (controlling for the positive relation between math achievement and math self-concept).

Methodologically, empirical tests of the I/E model consist of a regression model estimating the paths leading from math and verbal achievement to math and verbal self-concept while controlling for other relations. Möller, Pohlmann, Köller, and Marsh (2009) investigated these relations meta-analytically. The authors integrated 69 data sets, comprising $N = 125,308$ participants, evaluating the relations between math and verbal achievement and self-concept simultaneously. Whereas the correlation between math and verbal achievement was highly positive ($r = 0.67$), the correlation between math and verbal self-concepts was close to zero ($r = 0.10$). As predicted by the external frame of reference, paths from math achievement to math self-concept ($\beta = 0.61$) and from verbal achievement to verbal self-concept ($\beta = 0.49$) were positive. In accordance with the application of the internal frame of reference, paths from math achievement to verbal self-concept ($\beta = -0.21$) and from verbal achievement to math self-concept ($\beta = -0.27$) were significantly negative.

While the I/E model assumes that social and dimensional comparisons affect students' academic self-concept formation, it is important to note that this view is rather interpretive. In fact, studies of the I/E model usually investigate the relations between math and verbal achievement and self-concept, without elucidating the cognitive processes that lie behind the regression paths. However, several experimental studies have shown that social and dimensional comparisons are indeed two essential processes in the formation of students' academic self-concept (e.g., Möller & Köller, 2001; Müller-Kalthoff et al., 2017b; Pohlmann & Möller, 2006, 2009; Strickhouser & Zell, 2015). Moreover, diary studies have demonstrated that students spontaneously make social and dimensional comparisons in everyday life, especially in regard to academic matters (e.g., Möller & Husemann, 2006; Wheeler & Miyake, 1992). Thus, it is a plausible assumption that social and dimensional achievement comparisons are everyday processes that are used over a long period of time to form and differentiate students' academic self-concepts (Möller & Marsh, 2013). Furthermore, it is reasonable to conclude that these comparison processes might explain the path coefficients of the I/E model, at least in part.

Referring to the results of their meta-analysis, Möller et al. (2009) state that “the relations described in the classical I/E model are not restricted to a particular achievement or self-concept measure” (p. 1157). With respect to the achievement measures, this conclusion seems reasonable. The I/E model relations were found both when math and verbal achievement were measured with grades, and when this was done with standardized test results. However, concerning the self-concept measures, the statement may be a little premature. Indeed, the I/E model relations have been shown to generalize across various self-concept measures considering different components of self-concept. For example, while some measures only referred to cognitive-evaluative components of academic self-concept (e.g., Pohlmann & Möller, 2009), other measures additionally referred to affective or motivational components (e.g., Marsh, 1992a, 1992b, 1992c; Rost & Sparfeldt, 2002). However, all studies included in Möller et al.'s (2009) meta-analysis exclusively used quantitative closed-ended Likert scales to measure math and verbal self-concepts. Skaalvik and Skaalvik (2002) have already stressed that “to increase understanding of frames of

reference... researchers need to move beyond student self-reports to qualitative data using introspection and retrospection” (p. 242). To date, there is an apparent lack of studies measuring math and verbal self-concept with open-ended items.

Open-ended self-concept questions (e.g., “How do you see yourself in math?”), as opposed to closed-ended self-concept scales, encourage students to thoroughly focus on facets of their self-concept that have individual importance. Moreover, these facets can be different for the math and verbal areas. For example, a student might stress enjoyment of math, while thinking about German primarily in terms of achievement. It is rather unlikely that this student will feel drawn to compare these two different aspects dimensionally. Previous research has shown that respondents answering open-ended questions produce more diversified answers than do those answering closed-ended questions (e.g., Reja, Manfreda, Hlebec, & Vehovar, 2003; Schuman & Scott, 1987). However, it is as yet unclear whether the seemingly paradoxical I/E model-like patterns between math and verbal achievement and self-concept are still evident when self-concepts are measured with open-ended questions. Thus, it would be a valuable contribution to our knowledge to test whether the I/E model generalizes to data based on open-ended self-concept measures.

2. The present study

The goal of the present study was to test whether the typical I/E model patterns that have been found with closed-ended self-concept measures, would be replicated with open-ended self-concept measures. Open-ended and closed-ended self-concept measures differ in that open-ended measures allow students to describe their self-concept in their own words and with individual emphasis on selected self-concept aspects, while closed-ended measures ask students to rate certain statements regarding their self-concept on a Likert scale. However, we hypothesize that the I/E model will apply to both closed-ended and open-ended self-concept measures. As we note above, students use social and dimensional comparisons of their achievement over a long period of time, to form their academic self-concept (Möller & Husemann, 2006; Wheeler & Miyake, 1992). Thus, we assume that social and dimensional comparisons are so deeply rooted in students' self-perceptions that the I/E model-like patterns will be evidenced even when students are allowed to explicate their math and verbal self-concepts autonomously. This assumption is also supported by research showing the robustness of the I/E model relations across different age groups, gender groups and countries, and across questionnaires using different definitions of self-concept (Möller et al., 2009). We tested our hypothesis in an empirical field study assessing students' math and verbal achievement, as well as their open math and verbal self-concepts. Additionally, we assessed students' closed math and verbal self-concepts.

3. Method

3.1. Sample

A total of $N = 471$ students (62.6% female, mean age = 17.79, $SD = 2.32$) participated in our study. Students attended 27 different classes between Grade 10 and Grade 13 in four selective German high schools.

3.2. Measures

3.2.1. Achievements

As an indicator of students' math and verbal achievement, students indicated their grades in math and German (as first language)

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