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Running Head: INTEREST, SELF-CONCEPT, AND ACADEMIC PERFORMANCE

The Developmental Dynamics between Interest, Self-concept of Ability, and Academic Performance

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Abstract

Only a few studies have examined the direction of associations between academic achievement, interest, and self-concept of ability simultaneously by using longitudinal data over several school years. To examine the cross-lagged relationships between students' interest, self-concept of ability, and performance in mathematics and reading, longitudinal data from Grade 1 to Grade 7 of comprehensive school was gathered from 216 students. The results showed that, in both reading and math, performance predicted students' subsequent self-concept of ability. Some evidence was also found that math performance predicts subsequent interest in mathematics, and that self-concept of math ability mediates the impact of math performance on interest. No evidence was found for the assumption that self-concept of ability or interest would predict subsequent academic performance.

Keywords: Interest; self-concept of ability; mathematics; reading

Introduction

It has been suggested that highly motivated students with positive beliefs about their own abilities and competencies show high effort and engagement in learning (Ryan & Deci, 2000; Wigfield, Eccles, & Rodriguez, 1998), and, therefore, do well at school (Eccles, Wigfield, Harold, & Blumenfield, 1993; Murphy & Alexander, 2000). However, learning outcomes and related feedback, such as grades, also provide a basis for later competence beliefs and learning motivation (Eccles et al., 1983; Spinath &Spinath, 2005). Previous research on motivation and school performance has, however, two limitations. First, the majority of the previous studies has been cross-sectional or has concentrated only on relatively short time periods in students' school career. Second, only a few studies have examined the direction of influence between academic performance, self-concept of abilities and task-specific motivation simultaneously (see for example Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005; Skaalvik & Valas, 1999). Consequently, the present study investigated the cross-lagged associations between students' interest in reading and matehematics, related self-concept of ability, and school performance from 1st to 7th grade.

Interest and Self-concept of Ability

Achievement motivation theorists (Atkinson, 1964; Bandura, 1982, 1997; Weiner, 1985) suggested a long time ago that individuals' achievement-related beliefs and attitudes play an important role in academic environments. According to Pintrich and Schunk (1996), for example, students with positive self-perceptions of their

competence are more likely both to perform better and to engage in an adaptive manner in academic tasks than those with negative self-perceptions. Similarly, students who value and are interested in specific academic tasks are more likely perform better, learn more, and be more adaptively engaged in those tasks (Pintrich & Schunk, 1996).

The importance of beliefs, expectancies and interest were first introduced in one model by Eccles and her colleagues (1983) in their expectancy-value model of achievement motivation. It emphasizes two theoretical concepts: beliefs and expectancies related to academic situations, and subjective task values concerning different subject areas (see also Eccles & Wigfield, 1995; Wigfield & Eccles, 2000). According to this theory, expectancies and ability beliefs refer to students' beliefs about their competence in upcoming tasks and in a given task at hand. Concepts closely similar to these are perceived competence (Harter, 1982), and self-concept of ability (e.g. Nurmi & Aunola, 2005). The latter is used in the present study to refer to students' perceptions of their competence and task difficulty in a specific subject.

The value aspect of academic motivation in Eccles et al.'s (1983) theory, in turn, includes three components: Attainment value (the importance of doing well in a task in terms of self-schema), utility value (the instrumentality of a goal for reaching other goals), and intrinsic or interest value (the enjoyment one gets from engaging in an activity). Other concepts used to refer to motivation in a particular subject are intrinsic motivation (Deci, Vallerand, Pelletier, & Ryan, 1991; Gottfried, 1990; Harter, 1981) and interest (Schiefele, 1996). In the present study, we use the concept interest (to refer to how much students enjoy or like a certain school subject or a task, as it is close to the concept of intrinsic value in Eccles et al.'s (1983) theory.

Interest, Self-concept of Ability, and Academic Performance

There are a large number of studies on the relations between academicperformance and self-concept of ability. These studies have shown, on the one hand, that self-concept of ability contributes to subsequent academic achievement (for a review see Valentine, DuBois, and Cooper, 2004). For example, the studies by Eccles and her colleagues (Eccles et al., 1983; see also Wigfield & Eccles, 2002) found that among adolescents, self-perception of ability is one of the strongest predictors of subsequent performance even when controlled for the previous level of performance. Similarly, Marsh et al. (2005) found that self-concept of ability predicts both grades and standardized test scores among 7th-graders. On the other hand, academic achievement has also been found to provide a basis for positive self-concept. For example, Marsh et al. (2005) found that academic achievement predicted subsequent self-concept of ability among 7th-graders. These results have been interpreted to mean that self-concept of ability and academic achievement form a reciprocal cycle with high self-concept of ability leading to increased investment and performance, which in turn leads to further increases in self-concept of ability in related domains (Eccles et al., 1983; Marsh et al., 2005). It has also been found that the associations between students' academic performance and self-concept of ability become stronger in their later school years (Denissen, Zarrett, & Eccles, 2007; Eccles, Wigfield, & Schiefele, 1998).

Previous studies have also shown that interest in school subjects is associated with performance (Aunola, Leskinen, & Nurmi, 2006; Gottfried, 1990). However, the results on the direction of influence between these constructs are somewhat contradictory. Some studies have found that it is motivation that predicts subsequent

academic performance (Gottfried, Fleming, & Gottfried, 1994; Köller, Baumert, & Schnabel, 2001), whereas others have shown that it is rather previous achievement that predicts motivation (Deci et al., 1991; Gottfried, 1990; Skaalvik & Valas, 1999). Other studies have found that the relationships between interest and skill development are, in fact, reciprocal (Aunola et al., 2006; Marsh et al., 2005; Viljaranta, Lerkkanen, Poikkeus, Aunola, & Nurmi, 2009).

Two possible mechanisms may underlie the associations between self-concept of ability, interest, and academic performance. On the one hand, self-concept of ability provides a basis for interest in different school subjects, which then contributes to academic performance. Positive ability beliefs lead to higher motivation (e.g. Deci & Ryan, 1985; Wigfield & Eccles, 2000) and greater effort and investment (e.g. Wigfield et al., 1998) in academic tasks. This then leads to higher levels of performance (see Pintrich & Schunk, 1996). On the other hand, students' academic performance and related feedback may influence students' ability beliefs and interest. For example, Spinath and Spinath (2005) suggested that both competence beliefs and learning motivation rely strongly on normative ability feedback, such as grades. In addition, Eccles' model (Eccles et al., 1983, 1998) noted that earlier academic experiences, and related feedback provide the basis for the development of students' self-concept of ability which further influences on their subjective task values: students who are performing well in a certain subject also feel that they are competent in that subject, which then leads to higher interest and enjoyment of the subject (see also Deci et al., 1991; Gottfried, 1990; Köller et al., 2001)

One major limitation of the previous research is that only a few studies have examined the direction of influence between academic achievement, interest, and self-concept of ability simultaneously (Marsh et al., 2005; Skaalvik & Valas, 1999). In one

study, Marsh et al. (2005) investigated the cross-lagged associations between math-related self-concept of ability, interest, grades, and test scores among 7th-grade students in Germany. The results showed first, that the association between math-related self-concept of ability and math grades and test scores was reciprocal: self-concept of ability predicted subsequent math achievement but also math achievement predicted later self-concept of ability. However, the predictive power of test scores was stronger than the predictive power of grades. Second, self-concept of ability predicted also later interest in math and interest in math, in turn, was found to predict later self-concept of ability marginally significantly. No associations were found between interest and grades or test scores. However, Marsh et al. (2005) conducted also some additional, and in this research field more traditional, path analyses where they paired the different variables and examined the causal ordering among various pairs of the different constructs. The results of these models showed that some of the relatively small effects in the original model including all the four variables (i.e. self-concept of ability, interest, test scores and grades) where stronger when examining the constructs one pair at the time. One possible reason for this according to Marsh et al. (2005) might be the multicollinearity of the different constructs. Although the study by Marsh et al. was longitudinal, it included only two measurement points across one year and focused only on math-related self-concept of ability, interest and performance. In another study, Skaalvik and Valas (1999) investigated the cross-lagged associations between achievement, interest and self-concept of ability in relation to both mathematics and language arts among. Even though their study investigated three groups of students, i.e. 3rd-, 6th-, and 8th-graders, students were studies only twice, i.e., in the beginning and at the end of each grade. . They found

that academic achievement affected both subsequent self-concept and motivation, whereas self-concept and motivation did not predict academic performance.

Self-concept of ability as a mediator between academic performance and interest

To our knowledge there are no earlier studies examining whether self-concept of ability would act as a mediator between academic performance and interest. Studies that have examined the cross-lagged associations between all these three constructs simultaneously have included only two measurement points (Marsh et al., 2005; Skaalvik & Valas, 1999), which does not allow testing a mediator hypothesis. However, there is a reason to assume that self-concept of ability may act as a mediator between performance and interest. Namely, it has been suggested that students' self-concept of ability provides a basis for their interest in particular school subjects (Eccles et al., 1983; Wigfield & Eccles, 2002): individuals are more likely to be motivated to activities where they believe to have good capabilities and where they expect success. In fact, many studies have shown that interest and self-concept of ability are positively correlated (Deci & Ryan, 1985; Eccles & Wigfield, 1995; Gottfried, 1990; Harter; 1981), and that this positive association strengthens with age (Fredricks & Eccles, 2002; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Wigfield et al., 1997). However, only a few studies have examined the relations between interest and self-concept of ability by using longitudinal data. Moreover, the findings of these studies are contradictory. Jacobs et al. (2002), for example, found that decrease in competence beliefs accounted for a decline in task value from Grade 1 to Grade 12. However, they did not study cross-lagged associations between interest and self-concept of ability. Marsh et al. (2005), and Spinath and Steinmayr

(2008), in turn, examined the cross-lagged effects between interest and self-concept of ability in longitudinal studies lasting approximately one year. Marsh et al. (2005) found evidence for reciprocal relations between math-related interest and self-concept of ability, whereas Spinath and Steinmayr (2008) found a hardly observable relationship. Neither other longitudinal studies have found cross-lagged associations between interest and self-concept of ability over time (Skaalvik & Valas, 1999; Spinath & Spinath, 2005).

The present study aims to extend these prior studies by examining the lagged relations between interest, self-concept of ability and performance in both mathematics and reading by using longitudinal data over seven years, i.e., from the very beginning of comprehensive school to the 7th grade of comprehensive school.

Aims

The present study examined the following research questions:

1) Does students' academic performance in mathematics and reading predict their self-concept of ability and interest? Does the self-concept of ability mediate the impact of academic performance on interest? We hypothesized that academic performance would predict later self-concept of ability (Hypothesis 1a) (Marsh et al., 2005) and interest (Hypothesis 1b) (Deci et al., 1991; Gottfried, 1990; Skaalvik & Valas, 1999), and that the self-concept of ability would mediate the impact of academic performance on interest (Hypothesis 1c) (Eccles et al., 1983).

2) Does students' self-concept of ability predict their subsequent academic performance? We expected that a high level of self-concept of ability would predict later academic performance, as students with positive self-perceptions of their abilities

are more likely to show more effort, persistence and cognitive engagement in academic tasks (Hypothesis 2) (Wigfield & Eccles, 2002).

3) Does students' interest predict their subsequent academic performance? We expected that a high level of interest would predict subsequent academic performance, as students who value and are interested in specific subjects are more likely to enjoy tasks in those subjects, to be more adaptively engaged in them and to choose similar tasks in the future more (Hypothesis 3) (Gottfried et al., 1994; Köller et al., 2001). As previous findings are somewhat inconsistent, we expected that the cross-lagged associations between academic performance, on the one hand, and self-concept of ability and interest, on the other, may go either ways.

Method

The Finnish School System

The Finnish school system differs from its counterpart in many European countries and the United States. At age 7, Finnish children start comprehensive school which divides into a lower (grades 1-6) and an upper level (grades 7-9). After comprehensive school, the large majority of adolescents continue their secondary education for further three years, either in upper secondary school or in vocational school. Those who complete upper secondary school typically go on to universities or polytechnics. Those who complete vocational school either enter the labour market or go on to a polytechnic.

Participants

The present study is a part of the ongoing Jyväskylä Entrance into Primary School (JEPS) study (Nurmi & Aunola, 1999a), the aim of which is to examine children's academic and motivational development from the very beginning of their school career until the end of comprehensive school. The sample consisted of students from two medium-sized districts in central Finland. The two school districts were chosen because they included children growing up in both urban and semi-urban areas. The students were examined four times during their comprehensive school years. The sample size changed at each measurement point, because the students participating in the study relocated, refused to continue participation in the study or did not participate at certain measurement, and also some new students entered the examined classrooms. These changes in the sample are shown as random events of individuals to participate in this study. In Grade 1 the sample size was 216 (104 girls, 112 boys; 7-8 years old), in Grade 2 224 (8-9 years old), in Grade 4 228 (10-11 years old), and in Grade 7 231 (13-14 years old). However, of the original 216 students, 215 were also examined in Grade 2, 197 in Grade 4, and 187 in Grade 7. 178 students participated at each measurement point. Those students who dropped out of the study did not differ statistically significantly from other participants. At all the measurement points, students were interviewed or asked to fill in a questionnaire on their interest and self-concept of abilities in the spring term of the school year. Students' academic performance was assessed by questionnaires filled in by the students' teachers in Grades 1, 2 and 4. In Grade 7, students' academic performance was measured by self-report.

The number of classes varied from year to year. In Grade 1, the students came from 17 classes, in Grade 2 students came from 19 classes, in Grade 4 from 32 classes

(from 14 classes only one student participated) and in Grade 7 from 27 classes (from 16 classes only one student participated). The increase of classes over time was due to the fact that some of the original participants moved to another district and, thus, to another school. The class composition also changed from one year to another. In order to check out whether the students in the same class in certain year would be more similar with each other than with students coming from other classes, we calculated intraclass correlations for each study variable, separately for each year. The results showed that the intraclass correlations varied in interest between .003 and .095, in self-concept of ability between .03 and .068 and in academic performance between .011 and .095. In addition, we also calculated the design effects for each variable. According to Muthén (1999; see also Muthén & Satorra, 1995) "It is really not the size of the intraclass correlation that is the issue. It is the size of the design effect, which is a function of the intraclass correlation and the average cluster size. A design effect greater than 2 indicates that the clustering in the data needs to be taken into account during estimation. The design effect is approximately equal to 1 + (average cluster size - 1)*intraclass correlation." The design effects we calculated were all below 2. Therefore, no multilevel modeling was used in our study.

Measures

Interest.

Students' interest in reading and mathematics was assessed in the first, second and fourth grade in an interview using the Task Value Scale for Children (TVS-C; Nurmi & Aunola, 1999b, 2005; originally Eccles et al., 1983). This particular scale measures

only interest value component. The scale consisted of items measuring students' interest (i.e., interest in or liking for a particular task) in reading tasks (3 items: e.g., "How much do you like reading?") and in mathematical tasks (3 items: e.g. "How much do you like mathematics?"). In the measurement procedure, the students were first read the question. They were then shown a set of five faces drawn to depict an evaluative scale running from very positive to very negative. The students were then asked to point out the picture which most describes their liking for a particular subject (unhappy face/1 = "I do not like it at all/ I dislike doing those tasks"; happy face/5 = "I like it very much/I really enjoy doing those tasks").

In the seventh grade students' interest was assessed with a questionnaire asking 1) how much they like a) mathematics and b) Finnish language and 2) how much they like doing tasks related to a) mathematics and b) Finnish language (Eccles et al., 1983). The Cronbach alpha reliabilities for the interest assigned to mathematics were .88, .91, .93, and .84, respectively. The Cronbach alpha reliabilities for reading-related interest were .83, .81, .84, and .77, respectively.

Self-concept of ability.

Students' self-concept of ability in mathematics and reading was assessed in the first, second and fourth grades at an interview using the Self-Concept of Ability Scale (Nicholls, 1978; see also Aunola, Leskinen, Onatsu-Arvilommi, & Nurmi, 2002; Nurmi & Aunola, 2005). In the test, students were presented with a sheet of paper showing 20 faces in a line from the top to the bottom of the page. They were told that the faces represented students of the same age as themselves, and that the one at the top of the page represented the student who was best at mathematics, and so on, down

to the poorest performer. In the 1st and 2nd Grade students were asked about their self-concept of ability in reading by using one question and self-concept of ability concerning math by using two questions: “Now, can you show me how good you are at reading / at maths / at writing numbers? Which one are you?” The participants responded by pointing to one of the faces. The faces in the top of the page scored lower values. In Grade 4 the measurement procedure was the same, except that self-concept of ability in both reading and math was assessed by using one question (Can you show me how good you are at maths/ reading?). When the results for self-concept of ability are presented, the scale is reversed (i.e. the better a student thought he / she was, the bigger the value he / she scored for self-concept of ability).

In Grade 7students filled in a questionnaire (based on the ideas presented by Eccles & Wigfield, 1995) where they were asked 1) How good are you at mathematics / Finnish language?, 2) How good do you think you are at mathematics / Finnish language compared to the other students in your class?, and 3) How hard are tasks related to mathematics / Finnish language related tasks for you. The response scale was from 1 to 5. The Cronbach alpha reliabilities for self-concept in mathematics were .56 in Grade 1, .60 in Grade 2, and .87 in Grade 7. The reliability for self-concept in reading was .91 in Grade 7. If there was only one item for construct this was evaluated when estimating SEM models by setting the measurement errors equal every time it was possible. The reliabilities for self-concept in reading were .74 in Grade1 and.74 in Grade 2.

Academic performance.

Students' academic performance was assessed in the Grades 1 and 2 by asking the students' teachers to evaluate on a scale from 1 to 5 how good the students are at mathematics and reading. In Grade 4 teachers were asked to rate on a scale from 1 to 5 students' 1) comprehension and 2) technical reading skills, and the students' 1) mechanical and 2) applied skills in mathematics are . The teacher ratings of the students' academic performance have been shown to correlate highly with the students' test performance (Aunola & Nurmi, 2008). In Grade 7 students were asked to report their grade in mathematics and Finnish language from the preceding term (i.e. from the preceding autumn). Self-reported grade point average has been shown to correlate .96 with actual grade point average (Holopainen & Savolainen, 2005). The reliabilities for performance in mathematics were .72 in Grade 1, .77 in Grade 2, and .93 in Grade 4, and for performance in reading .77 in Grade 1, .77 in Grade 2, and .92 in Grade 4.

Analysis Strategy

All the analyses were done in two steps. First, in order to investigate stabilities of the constructs before entering concurrent and cross-lagged associations to the models, a stability model with four factors (measurement points) was built separately for each of the measured constructs, that is, academic performance, self-concept of ability, and interest, separately for math and reading. The gender differences in the variable means were controlled in each model by entering it as a control variable.

Second, the cross-lagged relations between performance, self-concept of ability and interest were examined according to the hypotheses, separately in math

and reading, in a following procedure: (1) A model including performance and self-concept was estimated without any cross-lagged paths between these two constructs. (2) Paths from performance at each measurement point to self-concept at following measurement point were estimated to test Hypothesis 1a. (3) Paths from self-concept at each measurement point to performance at following measurement point were estimated to test Hypothesis 2. (4) Cross-lagged paths from performance to later self-concept and from self-concept to later performance were estimated into the same model. (5) A model including performance and interest was estimated without any cross-lagged paths between these two constructs. (6) Paths from performance at each measurement point to interest at following measurement point were estimated to test Hypothesis 1b. (7) Paths from interest at each measurement point to performance at following measurement point were estimated to test Hypothesis 3. (8) Cross-lagged paths from performance to later interest and from interest to later performance were estimated into the same model. (9) A model including self-concept and interest was estimated without any cross-lagged paths between these two constructs. (10) Paths from self-concept at each measurement point to interest at following measurement point were estimated (11) Paths from interest at each measurement point to self-concept at following measurement point were estimated. (12) Cross-lagged paths from self-concept to later interest and from interest to later self-concept were estimated into the same model.

After each model was estimated, χ^2 difference test for nested models testing the needs of cross-lagged paths was used. (13) As a last step of the analyses, the statistical significance of the each single mediator effect from academic performance to interest via self-concept of ability was tested.

All the analyses were performed using the Mplus statistical package (Muthén & Muthén, 1998-2009). The model parameters were estimated using the MLR estimator, which is the robust method estimating the parameters in the case of non-normal distribution.

The missing values were assumed to be *missing at random* (MAR) and therefore *full-information maximum likelihood estimation* was used with standard errors that are robust against distribution (MLR; Muthén & Muthén,1998-2009).The goodness-of-fit of the estimated models were evaluated using five indicators: χ^2-test, Bentler's (1990) comparative fit index (CFI), the Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR). According to Hu & Bentler, 1999, values above .95 for TLI and CFI, values below .06 for RMSEA, and a value below .08 for SRMR can be considered as indicating good fit between the hypothesized model and the observed data. Table 1 shows the means, standard deviations and correlations for all the measured items concerning mathematics and Table 2 for all the measured items concerning reading.

Insert Tables 1 and 2 about here

Results

Stability Models

When building the stability model for *math performance* (χ^2 (4) = 7.73, *p* = .10, *CFI* = .99, *TLI* = .98, *RMSEA* = .06, *SRMR* = .02; see Figure 1), the measurement error of first and second measurement were set equal in order to estimate the error variance. With this we were able to evaluate the reliabilities of the single-item constructs. The model showed high stabilities between successive measurements of math performance (Figure 1). Similar models for *math-related self-concept of ability* (χ^2 (18) = 21.31, *p* = .26, *CFI* = .99, *TLI* = .98, *RMSEA* = .03, *SRMR* = .04; see Figure 1) and *math-related interest* model (χ^2 (41) = 39.66, *p* = .53, *CFI* = 1.00, *TLI* = 1.00, *RMSEA* = .00, *SRMR* = .05; see Figure 1) were conducted. The stabilities of self-concept of ability and interest were moderate across time (Figure 1).

Insert Figure 1 about here

When building the stability model for *reading performance* (χ^2 (4) = 0.66, *p* = .96 ., *CFI* = 1.00, *TLI* = 1.00, *RMSEA* = .00, *SRMR* = .00; see Figure 2) the measurement errors of first and second measurement were again set equal in order to estimate the error variance. With this we were able to evaluate the reliabilities of the single-item measures of performance. The model showed high stabilities between successive measurements, especially between Grade 1 and Grade 2, as well as between Grade 2 and Grade 4 (Figure 2). In case of *reading-related self-concept of ability* (χ^2 (7) = 14.76, *p* < .05, *CFI* = .98, *TLI* = .93, *RMSEA* = .06, *SRMR* = .04; see Figure 2), measurement errors of first and second measurement were set equal. In

addition, the modification indices suggested that the path between Grades 1 and 7 should be added into the model. The model showed moderate stabilities between successive measurements, especially between Grade 1 and Grade 2, as well as between Grade 2 and Grade 4. Since modification indices suggested that the path between Grades 1 and 7 should also be estimated, the stability between Grades 4 and 7 had to be calculated separately, and it appeared to be .27 (Figure 2). Finally, the stability model for *reading-related interest* (χ^2 (40) = 45.37, p = .26, *CFI* = .99, *TLI* = .99, *RMSEA* = .02, *SRMR* = .04; see Figure 2) showed moderate or low stabilities between successive measurements.

Insert Figure 2 about here

Full models

Model for Mathematics. In the second step of the analyses, separate models that combined the previous models for academic performance, self-concept of ability, and interest were created for a) math (Figure 3) and b) reading (Figure 4). The model included stability coefficients as well as cross-lagged paths. The results for this final math model (χ^2 (228) = 313.449, p < .01, *CFI* = .97, *TLI* = .96, *RMSEA* = .04, *SRMR* = .07; see Figure 3) showed that math performance at each time point predicted self-concept of ability at the next time point: the better math performance was, the more positive was self-concept of ability later on. The results showed further that self-concept of ability also predicted interest later on: the more positive the child's self-

concept of ability was in Grade 2 and Grade 4, the higher also was his / her interest in the next measurement point. In no case did self-concept of ability predict later academic performance or interest predict self-concept of ability or academic performance.

To test the statistical significance of the mediator effects from academic performance to later interest via self-concept of ability the indirect effects were calculated. For the mediator effect from academic performance at Grade 2 to interest at Grade 7 via self-concept of ability at Grade 4 the standardized value was 0.06 ($p < .05$) Therefore, the mediator effect was statistically significant. The mediator effect from academic performance at Grade 1 to interest at Grade 4 via self-concept of ability at Grade 2 (standardized value 0.06), in turn, was statistically marginally significant ($p < .10$).

When examining associations between the different constructs at the same time points (correlations in Grade 1 and residual correlations between error terms in other measurements) the results showed positive associations between math performance and self-concept of ability in Grade 1 (.30, $p < .01$), Grade 4 (.26, $p < .01$), and Grade 7 (.67, $p < .001$), between self-concept of ability and interest in Grade 1 (.50, $p < .001$), Grade 2 (.63, $p < .001$), Grade 4 (.33, $p < .001$), and Grade 7 (.71, $p < .001$), and between performance and interest in Grade 1 (.34, $p < .001$), Grade 4 (.24, $p < .01$) and Grade 7 (.33, $p < .001$).

Insert Figure 3 about here

The model for reading. The results for reading (χ^2 (184) = 196.188, p = .26, *CFI* = 1.00, *TLI* = .99, *RMSEA* = .02, *SRMR* = .05; Figure 4) showed, first, that reading performance at Grade 1 predicted self-concept of ability at Grade 2 and performance at Grade 4 predicted self-concept of ability at Grade 7: the better reading performance was, the more positive was self-concept of ability later on. Third, self-concept of ability predicted interest in two cases: the more positive a student's self-concept of ability was in Grade 2, the higher also was also his / her interest in Grade 4. Moreover, the more positive a student's self-concept of ability was in Grade 4, the higher also was also his / her interest in Grade 7.

In no case did self-concept of ability predict later academic performance or interest predict self-concept of ability or academic performance.

To test the mediator effect from academic performance at Grade 1 to interest at Grade 4 via self-concept of ability at Grade 2, the standardized value of the indirect effect was 0.09. The mediator effect was statistically marginally significant ($p < .10$).

When examining associations between the different constructs at the same time points the results showed positive associations between performance and self-concept of ability in Grade 1 (.62, $p < .001$), , Grade 4 (.24, $p < .05$), and Grade 7 (.53, $p < .001$). The results also showed positive associations between self-concept of ability and interest in Grade 2 (.53, $p < .001$), Grade 4 (.29, $p < .01$), and Grade 7 (.66, $p < .001$) and between performance and interest in Grade 4 (.22, $p < .05$), and Grade 7 (.28, $p < .001$).

Insert Figure 4 about here

Discussion

The aim of the present study was to examine the developmental dynamics, that is, cross-lagged associations between students' interest, self-concept of ability, and academic performance in mathematics and reading as students moved from the first school year to the seventh grade of comprehensive school. The results showed, in particular, that both reading and math performance predicted students' self-concept of ability later on. Evidence was also found for that self-concept of ability mediated the association between performance and interest. Moreover, no evidence was found for the assumption that self-concept of ability or interest would predict subsequent math and reading performance.

The first research question of the present study was to examine whether the students' academic performance in mathematics and reading would predict their related self-concept of ability and interest, and whether self-concept of ability would mediate the impact of academic performance on interest. As expected (Hypothesis 1a), the results showed that students' academic performance in both math and reading predicted their subsequent self-concept of ability. In the case of mathematics, the higher performance at certain measurement was, the more positive was students' self-concept of ability at next measurement point. In reading this was true from first to second grade, as well as from Grade 4 to Grade 7: the higher performance in reading was, the more positive was students' reading-related self-concept of ability later on. This result is in line with Eccles' expectancy-value model according to which earlier academic experiences and related feedback provide the basis for the development of students' self-concept of ability (Eccles et al., 1983; Eccles et al., 1998). This relation

has also been found in many previous studies carried out among both younger (Aunola, Leskinen, et al., 2002; Chapman & Tunmer, 1997) and older (Marsh et al., 2005) students. Students' performance may be associated with their self-concept of ability via many mechanisms. For example, teachers communicate their conceptions of the level of their students' performance in many ways in the daily classroom situations which then provides students with a salient source of feedback about their performance. This, in turn, affects students' beliefs in their abilities (Gottfried, 1990). In addition, other processes such as social comparisons with other students may play a role in how students' performance contributes to their self-concept of ability.

One interesting finding of the present study was that in mathematics performance predicted self-concept of ability at each consecutive measurement point, whereas in reading the same was true from Grade 1 to Grade 2 and from Grade 4 to Grade 7. This result may be due to the fact that the processes of learning literacy and mathematics differ from each other. The nature of Finnish language makes it relatively easy for children to learn to read, and the large majority of them achieve an accurate and fluent word reading skill before the end of the first school year (Aunola, Nurmi, Niemi, Lerkkanen, & Rasku-Puttonen, 2002; Seymour, Aro, & Erskine, 2003). This might explain why students' skills in reading predicted their reading-related self-concept of ability in the very beginning of their school career: the beliefs concerning one's abilities are established while learning to read, which typically takes place before the end of the second grade. During later schooling different kinds of skills in reading, such as reading comprehension, are learned. This might be another important point of schooling during which reading skills might play an especially important role on students' ability beliefs. By contrast, learning mathematics happens in a hierarchical manner: learning basic skills is a necessary foundation for mastering

more complex skills and procedures (Entwisle & Alexander, 1990). Therefore, it is a process during which children's individual differences tend to increase continuously during the school years (Aunola, Leskinen, Lerkkanen & Nurmi, 2004). Hence, these increasing individual differences are also likely to be reflected in children's self-concept of abilities.

Our results provided no support for our Hypothesis 1b suggesting that academic performance predicts subsequent interest. This is an interesting finding, since previous research has shown relatively strong evidence for the relation between performance and interest (see e.g. Deci et al., 1991; Gottfried, 1990; Köller et al., 2001; Viljaranta et al., 2009): students who perform well at school continue enjoying academic tasks more than students who have difficulties in academic topics. However, the most important finding in the present study was the result concerning the mediator effect of self-concept of ability in the relation between academic performance and interest (Hypotheses 1 c). According to our results the effect from academic performance to later interest goes, actually, via self-concept of ability. The results showed that students who performed better in mathematics showed more positive self-concept of ability which then predicted their later interest in mathematics. Some evidence was also found in the case of reading during the beginning of school career. Overall, these results suggest that students who are performing well in mathematics and reading also feel that they are competent in it, which then leads to higher interest in and enjoyment of these subjects. This result adds in an important way to several earlier results showing that students' self-concept of ability predicts their later interest (Eccles et al., 1983, Eccles et al., 1993; Jacobs et al., 2002; Marsh et al., 2005; Wigfield & Eccles, 2000), by indicating it is actually students' actual performance that contributes to their later interest via these ability beliefs. Eccles' expectancy-

value model has suggested this relation to exist (Eccles et al., 1983;Eccles et al., 1998) but it has not been empirically tested with longitudinal cross-lagged data spanning over several years. Although some of the mediating effects were statistically only marginally significant, our results indicate that students' earlier academic experiences and related feedback provide the basis for their later ability beliefs which further predicted interest in different subjects.

Our second and third research questions were whether students' self-concept of ability or interest would predict their subsequent academic performance. Surprisingly, no support was found for our Hypothesis 2 or Hypothesis 3 suggesting that a high level of self-concept of ability or interest would contribute to later academic performance. Our findings are surprising since there are several previous studies showing strong associations between self-concept of ability and later performance (e.g. Marsh et al., 2005; see also Marsh & Craven, 2006; Valentine et al., 2004) as well as between interest and later performance (e.g. Aunola et al., 2006; Ecalle, Magnan, & Gibert, 2006; Gottfried, 1990; Viljaranta et al., 2009; Wigfield, 1997). There are several possible reasons why our results were different from many previous ones. First, our study spanned seven years of schooling starting from grade 1, whereas several other studies, especially concerning self-concept of ability, have concentrated on older students (e.g. Marsh et al. 2005). Thus, it is possible that the impact of self-concept of ability on later academic performance is particularly evident during later school years, when the self-concept of ability has become more stable. During the comprehensive school years students receive a growing amount of feedback on their performance and skill development. As they get older they may also become better able to integrate this feedback with the beliefs that they have about their skills, strengths and weaknesses (Wigfield & Eccles, 2000; Stipek & Mac Iver,

1989). This development finally leads to more stabilized self-concept of ability which then could have more powerful effect on later academic performance. Also in the case of interest it is possible, as suggested by Köller et al. (2001) and Wigfield and Eccles (1992, 2000), that the role of interest as a predictor of academic outcomes may become more important in the later school years, when students have to make active decisions concerning the future course of their education. Second, our study investigated the cross-lagged associations across one year (from Grade 1 to Grade 2), across two years (Grade 2 to Grade 4) and across three years (Grade 4 to Grade 7). Therefore, our results may have turned out to be different if the measurements had been conducted at shorter intervals than over two or three years. For example, it is possible that the impact of self-concept of ability and interest does not span over more than one year of students' school careers. Therefore, it is possible that in order to capture the developmental dynamics and all the possibly existing associations between self-concept of ability or interest and academic performance, the measurements should have been conducted at shorter intervals, which usually has been the case in previous studies finding a cross-lagged association. Third, academic skills show substantial stability over time. Therefore, it may be difficult to find constructs that can statistically significantly predict such a stable construct over a long period of time by using the kind of method used in the present study. Due to the relatively low stability of self-concept of ability and interest, it is more plausible that performance predicts this variable rather than vice versa (i.e., because self-concept is not as stable as performance, it is more prone to external impacts. One additional reason for the differences between our results and those showing a strong predictive power from self-concept or interest to later performance is the differences in analyzing the data. As Marsh et al. (2005) suggest, the multicollinearity of the

different constructs might lead to weaker associations between different constructs in models including more than two constructs, compared to models where associations between only two different constructs are examined.

Finally, in the model concerning reading the modification indexes suggested that there should be a path from reading-related self-concept of ability from Grade 1 to Grade 7. This result indicates that reading-related self-concept of ability in Grade 1 includes some information that is valuable in predicting the same variable in Grade 7 that is not present in Grade 2 and Grade 4 measurements. For example, it is possible that self-concept of ability is not only impacted by the level of reading skills but also some attitudinal variables, like optimism, which is independent of the development of reading skills.

The results of the present study have important practical implications for teachers and other important adults working with students: students' academic performance and related feedback can have long-term effects on their beliefs about themselves as learners and, through these beliefs, on their task motivation. Our results suggest that in order to provide every student with positive learning experiences, teachers should give special attention to the ways in which they encourage and give feedback to students differing in their level of performance.

There are also some limitations that should be taken into account in any attempts to generalize the findings of the present study. First, some of the constructs were measured by only one item. In the case of these constructs, we made an effort to evaluate the reliability of these items when estimating SEM models by setting the measurement errors equal every time it was possible, although this is not an ideal solution for this problem. However, in the third measurement of self-concept of ability it was not possible to estimate the error variance, the associations to the other

factors in the model are under-estimated and the statistical power to find statistically significant associations is lowered. These effects are, however, small. Second, academic performance was measured by teacher-ratings, not by actual test performance. Although teacher-ratings have been shown to correlate highly with students' performance (Hecht & Greenfield, 2002), it is possible that test results may have given somewhat different result. Third, in grade 7 self-report of grades in math and reading were used. A reason for changing the measure concerning performance was that during the first three measurement points teachers filled in a questionnaire concerning students' skills in reading and math. However, at Grade 7 students don't have just one teacher to teach them like during the earlier school years, and, therefore, teachers were not asked to participate the study anymore. Although in another Finnish data self-reported grade point average has been shown to correlate highly with actual grade point average (.96; Holopainen & Savolainen, 2005), the results from self-reports should be interpreted with caution (Kuncel, Credé, & Thomas, 2005). Fourth, the measures were not identical across measurement points. There are several reasons for this. Most importantly, our study spanned over several years and it would have been difficult to use identical measures with children from grade 1 to grade 7. The contents of school subjects change and, consequently, it is not too reasonable to evaluate the self-concept, for example, in the same way thorough all grades. Also, when getting older, pupils are more capable to answer more detailed questions concerning their self-concept. However, even though our measures were not equal at different measurement points, the reliabilities of our measures were relatively good across time. In addition, there is no reason to expect the differences in measures to have a notable effect on the cross-lagged paths that were the main focus of the present study. It is possible, however, that the differences could have an effect to the

stabilities of each measured construct over time so that the stabilities might be somewhat lower when different measures have been used, compared to identical measures over time. Fifth limitation of the study is that the measurements were conducted at intervals of from one to three years. It is possible that in order to capture the developmental dynamics between self-concept, interest and performance the measurements should have been conducted at shorter intervals. Finally, the present study does not focus on the associations between different school subjects. In future it would be interesting to examine, whether, for example, good skills and high self-concept of ability in one subject are related to lower level of skills and self-concept in another subject (the Internal / External frame of reference model, see e.g. Marsh, 1986; Marsh & Hau, 2004).

The results of the present study increase our understanding of the developmental dynamics between students' academic performance, self-concept of ability, and interest by showing that during comprehensive school it is particularly students' academic performance in mathematics and reading that is associated with their subsequent ability beliefs, and, in the case of mathematics, through that, also to their interest. The findings have important practical implications for teachers and other important adults working with students: students' academic performance and related feedback can have long-term effects on their beliefs about themselves as learners and, through these beliefs, on their interest. Our results suggest that in order to provide every student with positive learning experiences, teachers should give special attention to the ways in which they encourage and give feedback to students differing in their level of performance.

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References

Atkinson, J. W. (1964). *An introduction to motivation.* Princeton, NJ: Van Nostrand.

Aunola, K., Leskinen, E., Lerkkanen, M.-K., & Nurmi, J.-E. (2004). Developmental dynamics of math performance from preschool to Grade 2. *Journal of Educational psychology, 96,* 699-713.

Aunola, K., Leskinen, E., & Nurmi, J.-E. (2006). Developmental dynamics between mathematical performance, task motivation and teachers' goals during the transition to primary school. *British Journal of educational Psychology, 76,* 21-40.

Aunola, K., Leskinen, E., Onatsu-Arvilommi, T., & Nurmi, J.-E. (2002). Three methods for studying developmental change: A case of reading skills and self-concept. *British Journal of Educational Psychology, 72,* 343-364.

Aunola, K., & Nurmi, J.-E. (2008). Correlation table of children's test performance and teacher-ratings. JEPS data. Unpublished data. University of Jyväskylä.

Aunola, K., Nurmi, J.-E., Niemi, P., Lerkkanen, M.-K., & Rasku-Puttonen, H. (2002). Developmental dynamics of achievement strategies, reading performance, and parental beliefs. *Reading Research Quarterly, 37,* 310-327.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37,* 122-147.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: Freeman.

Bentler, P. M. (1990). Comparative fit index in structural models. *Psychological Bulletin, 107*, 238-246.

Chapman, J. W., & Tunmer, W. E . (1997). A longitudinal study of beginning reading achievement and reading self-concept. *British Journal of Educational Psychology , 67*, 279–291.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.

Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist, 26*, 325-346.

Denissen, J. J. A., Zarrett, N. R., & Eccles, J. S. (2007). I like to do it, I'm able, and I know I am: Longitudinal couplings between domain-specific achievement, self-concept, and interest. *Child Development, 78*, 430-447.

Ecalle, J., Magnan, A., & Gibert, F. (2006). Class size effects on literacy skills and literacy interest in first grade: A large-scale investigation. *Journal of School Psychology, 44*, 191–209.

Eccles, J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives* (pp. 75-146). San Francisco: Freeman.

Eccles, J. S., & Wigfield, A. (1995). In the mind of the actor: The structure of adolescents' achievement task value and expectancy-related beliefs. *Personality and Social Psychology Bulletin, 21*, 215-225

Eccles, J. S., Wigfield, A., Harold, R. D., & Blumenfield, P. (1993). Age and gender differences in children's self- and task perceptions during elementary school. *Child Development, 64*, 830-847.

Eccles, J. S., Wigfield, A., & Schiefele, U. (1998). Motivation to Succeed. In W. Damon (Series Ed.) and N. Eisenberg (Vol. Ed.), *Handbook of Child Psychology, 5th edition, volume 3*. New York: Wiley.

Entwisle, D. R., & Alexander, K. L. (1990). Beginning school math competence: Minority and majority comparisons. *Child Development, 61,* 454-471.

Fredricks, J. A., & Eccles, J. S. (2002). Children's competence and value beliefs from childhood through adolescence: Growth trajectories in two male-sex-typed domains. *Developmental Psychology, 38,* 519-533.

Gottfried, A. E. (1990). Academic intrinsic motivation in young elementary school children. *Journal of Educational Psychology, 82,* 525-538.

Gottfried, A. E., Fleming, J. S., & Gottfried, A. W. (1994). Role of parental motivational practices in children's academic intrinsic motivation and achievement. *Journal of Educational Psychology, 86,* 104-113.

Harter, S. (1981). A new self-report scale of intrinsic versus extrinsic orientation in the classroom: Motivational and informational components. *Developmental Psychology, 17,* 300-312.

Harter, S. (1982). The perceived competence scale for children. *Child Development, 53,* 87-97.

Hecht, S. A., & Greenfield, D. B. (2002). Explaining the predictive accuracy of teacher judgements of their students' reading achievement: The role of gender, classroom behaviour, and emergent literacy skills in a longitudinal sample of children exposed to poverty. *Reading and Writing: An Interdisciplinary Journal, 15,* 789-809.

Holopainen, L., & Savolainen, H. (2005). Correlation table of self-reported grade point average and actual grade point average. Unpublished raw data. University of Joensuu and University of Jyväskylä, Finland.

Hu, L.-T., & Bentler, P. M. (1999). Cutoff criterion for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6,* 1-55.

Jacobs , J. E., & Lanza, S., Osgood, D. W., Eccles, J. S., & Wigfield, A. (2002). Changes in children's self-competence and values: Gender and domain differences across grades one through twelve. *Child Development, 73,* 509-527.

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

Köller, O., Baumert, J., & Schnabel, K. (2001). Does interest matter? The relationship between academic interest and achievement in mathematics. *Journal of Research in Mathematics Education, 32,* 448-470.

Marsh, H.W. (1986). Verbal and math self-concepts: An internal/external frame of reference model. *American Educational Research Journal, 23,* 129-149.

Marsh, H. W. & Craven, R. G. (2006). Reciprocal effects of self-concept and performance from a multidimensional perspective. *Perspectives on Psychological Science, 1,* 133–163.

Marsh, H. W., & Hau, K. T. (2004). Explaining paradoxical relations between academic self-concepts and achievements: Cross-cultural generalizability of the internal/external frame of reference predictions across 26 countries. *Journal of Educational Psychology, 96,* 56-67.

Marsh, H. W., Trautwein, U., Lüdtke, O., Köller, O., & Baumert, J. (2005). Academic self-concept, interest, grades, and standardized test scores: Reciprocal effects models of causal ordering. *Child Development, 76*, 397-416.

Murphy, P. K., & Alexander, P. A. (2000). A motivational exploration of motivation terminology. *Contemporary Educational Psychology, 25,* 3-53.

Muthén, L. K. (1999, October 29.). [Online forum comment]. Retrieved from http://www.statmodel.com/discussion/messages/12/18.html

Muthén, L. K., & Muthén, B. O. (1998-2009). *Mplus user's quide.* Los Angeles, CA: Muthén & Muthén.

Muthén, B., & Satorra, A. (1995). Complex sample data in structural equation modeling. In P. Marsden (Ed.), *Sociological Methodology 1995,* see 216-316. Boston: Blackwell.

Nicholls, J. G. (1978). The development of the concepts of effort and ability, perception of academic attainment, and the understanding that difficult tasks require more ability. *Child Development, 49,* 800-814.

Nurmi, J.-E. & Aunola, K. (1999a). *Jyväskylä Entrance into Primary School study (JEPS; ongoing)*. University of Jyväskylä, Finland. Nurmi, J.-E., & Aunola, K. (1999b). *Task-value scale for children (TVS-C).* Unpublished test material. University of Jyväskylä, Finland.

Nurmi, J.-E., & Aunola, K. (2005). Task-motivation during the first school years: A person-oriented approach to longitudinal data. *Learning and Instruction, 15,* 103-122.

Pintrich, P. R., & Schunk, D. H. (1996). *Motivation in education: Theory, research, and applications.* Englewood Cliffs, NJ: Merrill Prentice-Hall.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology, 25*, 54-67.

Schiefele, U. (1996). Topic interest, text representation, and quality of experience. *Contemporary Educational Psychology, 2*, 237-244.

Seymour, P. H. K., Aro, M., & Erskine, J. M. (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology, 94,* 143-174.

Skaalvik, E. M., & Valas, H. (1999). Relations among achievement, self-concept, and motivation in mathematics and language arts: A longitudinal study. *Journal of Experimental Education, 67,* 135-149.

Spinath, B., & Spinath, F. M. (2005). Longitudinal analysis of the link between learning motivation and competence beliefs among elementary school children. *Learning and Instruction, 15,* 87-102.

Spinath, B., & Steinmayr, R. (2008). Longitudinal analysis of intrinsic motivation and competence beliefs: Is there a relation over time? *Child Development, 79,* 1555-1569.

Stipek, D. J., & Mac Iver, D. (1989). Developmental change in children's assessment of intellectual competence. *Child Development,* 60**,** 521-538.

Valentine, J. C., DuBois, D. L., & Cooper, H. (2004). The relation between self-beliefs and academic achievement: A meta-analytic review. *Educational Psychologist, 39,* 111-133.

Viljaranta, J., Lerkkanen, M.-K., Poikkeus, A.-M., Aunola, K., & Nurmi, J.-E. (2009). Cross-lagged relations between task motivation and performance in arithmetic and literacy in kindergarten. *Learning and Instruction,19,* 335-344.

Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review, 92,* 548-573.

Wigfield, A. (1997). Reading motivation: a domain-specific approach to motivation. *Educational Psychologist, 32*,59-68.

Wigfield, A., & Eccles, J. S. (1992).The development of achievement task values: A theoretical analysis. *Developmental Review, 12*, 1-46.

Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology, 25*, 68-81.

Wigfield, A., & Eccles, J. S. (2002). The development of competence beliefs, expectancies for success, and achievement values from childhood through adolescence. In A. Wigfield, J. S. Eccles, & the Institute for Research on Women and Gender (Eds.) *Development of Achievement Motivation* (pp. 91-120). San Diego, CA: Academic Press.

Wigfield, A., Eccles, J. S., & Rodriguez, D. (1998). The development of children's motivation in school contexts. *Review of Research in Education, 23*, 73-118.

Wigfield, A., Eccles, J. S., Yoon, K. S., Harold, R. D., Arbreton, A. J. A., Freedman-Doan, C., & Blumenfield, P., C. (1997). Change in children's competence beliefs and subjective task values across the elementary school years: A 3-year study. *Journal of Educational Psychology, 89*, 451-469.

Figure Captions

Figure 1. Stability models for Math-related skills, self-concept of ability, and interest. Standardized solution. *Note 1. *p < .05; ** p < .01; *** p < .001.*

Figure 2. Stability models for Reading-related skills, self-concept of ability, and interest. Standardized solution. *Note 1. *p < .05; ** p < .01; *** p < .001.*

Figure 3. Full model for Math related skills, self-concept of ability, and interest. Standardized solution. *Note 1. *p < .05; ** p < .01; *** p < .001.*

Figure 4. Full model for Reading-related skills, self-concept of ability, and interest. Standardized solution. *Note 1. *p < .05; ** p < .01; *** p < .001.*

Table 1

Correlations of Items of math-related measures

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. How good at maths 1	1																							
2. How good in writing numbers 1	.40[a]	1																						
3. How good at maths 2	.37[a]	.24[a]	1																					
4. How good in writing numbers 2	.23[a]	.15[c]	.44[a]	1																				
5. How good at maths 4	.30[a]	.15[c]	.46[a]	.27[a]	1																			
6. How good in mathematics 7	.14[d]	.09	.18[c]	.01	.39[a]	1																		
7. How good compared to others 7	.30[a]	.22[b]	.18[c]	.01	.39[a]	.72[a]	1																	
8. How hard is mathematics 7	.11	.01	.14[d]	.01	.36[a]	.72[a]	.62[a]	1																
9. How much likes mathematics 1	.50[a]	.08	.18[b]	.05	.19[b]	.27[a]	.38[a]	.20[b]	1															
10. How much likes doing math-related tasks at school 1	.48[a]	.14[c]	.16[c]	.04	.24[b]	.23[b]	.37[a]	.19[b]	.76[a]	1														
11. How much likes doing math-related tasks at home 1	.42[a]	.04	.05	.02	.09	.15[c]	.24[b]	.12[d]	.67[a]	.69[a]	1													
12. How much likes mathematics 2	.16[c]	.03	.47[a]	.09	.26[a]	.23[b]	.17[c]	.17[c]	.38[a]	.36[a]	.38[a]	1												
13. How much likes doing math-related tasks at school 2	.22[b]	.07	.49[a]	.13[c]	.25[b]	.25[b]	.19[b]	.18[c]	.34[a]	.36[a]	.35[a]	.82[a]	1											
14. How much likes doing math-related tasks at home 2	.08	.09	.44[a]	.15[c]	.18[b]	.16[c]	.10	.11	.26[a]	.25[a]	.27[a]	.72[a]	.75[a]	1										
15. How much likes mathematics 4	.21[b]	.12	.39[a]	.20[b]	.45[a]	.30[a]	.29[a]	.29[a]	.20[b]	.19[b]	.19[b]	.39[a]	.44[a]	.33[a]	1									
16. How much likes doing math-related tasks at school 4	.17[c]	.09	.34[a]	.11	.42[a]	.28[a]	.28[a]	.27[a]	.21[b]	.23[b]	.22[b]	.42[a]	.44[b]	.31[a]	.87[a]	1								

17. How much likes doing math-related tasks at home 4	.19[b]	.18[c]	.29[a]	.18[b]	.39[a]	.23[b]	.26[a]	.20[b]	.24[b]	.28[a]	.26[a]	.37[a]	.41[a]	.30[a]	.79[a]	.80[a]	1								
18. How much likes mathematics 7	.13[d]	.03	.12	.07	.31[a]	.59[a]	.54[a]	.58[a]	.23[b]	.28[a]	.26[a]	.14[d]	.20[b]	.09	.37[a]	.33[a]	.34[a]	1							
19. How much likes to do tasks related to mathematics 7	.07	.04	.06	.10	.24[b]	.47[a]	.40[a]	.51[a]	.20[b]	.25[a]	.29[a]	.15[c]	.20[b]	.12[d]	.38[a]	.36[a]	.35[a]	.73[a]	1						
20. How good the student is at mathematics 1 (TE)	.35[a]	.29[a]	.36[a]	.13[d]	.41[a]	.46[a]	.48[a]	.29[a]	.35[a]	.26[a]	.12[d]	.19[b]	.17[c]	.10	.14[d]	.10	.10	.18[c]	.09	1					
21. How good the student is at mathematics 2 (TE)	.28[a]	.25[a]	.29[a]	.01	.41[a]	.48[a]	.48[a]	.29[a]	.33[a]	.26[a]	.15[c]	.20[b]	.17[b]	.10	.26[a]	.23[b]	.19[b]	.13[d]	.04	.72[a]	1				
22. How good are studentds mechanical math skills 4 (TE)	.24[b]	.21[b]	.28[a]	.09	.44[a]	.49[a]	.45[a]	.29[a]	.27[a]	.20[b]	.06	.12[d]	.13[d]	.06	.27[a]	.23[b]	.17[c]	.17[c]	.06	.63[a]	.67[a]	1			
23. How good are studentds applied math skills 4 (TE)	.27[a]	.18[c]	.23[c]	.05	.47[a]	.55[a]	.52[a]	.34[a]	.28[a]	.20[b]	.11	.12	.14[c]	.03	.27[a]	.24[a]	.20[b]	.26[a]	.16[c]	.64[a]	.69[a]	.88[a]	1		
24. Grade in mathematics 7	0.12	.15[c]	.11	.04	.33[a]	.69[a]	.64[a]	.48[a]	.29[a]	.20[b]	.15[c]	.13[d]	.19[c]	.07	.18[c]	.17[c]	.14[d]	.33[a]	.32[a]	.47[a]	.55[a]	.54[a]	.59[a]	1	
M	4.90	3.53	5.23	4.05	6.96	3.36	3.29	2.56	4.1	4.03	4.09	3.96	3.99	4.04	3.86	3.87	3.79	2.76	2.95	3.84	3.65	3.76	3.23	7.9	
SD	4.57	3.49	3.91	3.38	3.81	0.92	0.92	0.97	1.21	1.24	1.22	1.24	1.17	1.14	1.11	1.09	1.12	1.15	1.07	1.03	1.11	1.01	1.24	1.06	
Scale	1-20	1-20	1-20	1-20	1-20	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	4-10	

Note 1. TE = Teacher's evaluation

Note 2. [a] $p < .001$; [b] $p < .01$; [c] $p < .05$; [d] $p < .10$.

Note 3. The means and standard deviations for items 1-5 and 8 are the values before reversing the scale for the analysis.

Table 2

Correlations of Items of reading-related measures

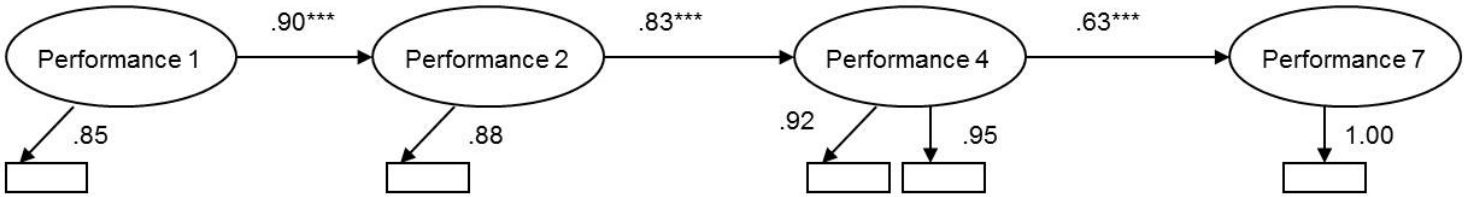
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1. How good at reading 1	1																					
2. How good at reading 2	.43[a]	1																				
3. How good at reading 4	.31[a]	.50[a]	1																			
4. How good in Finnish language 7	.27[a]	.17[c]	.22[b]	1																		
5. How good compared to others 7	.29[a]	.15[c]	.30[a]	.69[a]	1																	
6. How hard is Finnish language 7	.12[d]	.01	.11	.57[a]	.53[a]	1																
7. How much likes reading 1	.16[c]	.04	.06	.12	.06	.09	1															
8. How much likes doing reading-related tasks at school 1	.12[d]	.04	.08	.06	.03	.06	.69[a]	1														
9. How much likes doing reading-related tasks at home 1	.14[c]	.09	.04	.01	.05	.01	.55[a]	.60[a]	1													
10. How much likes reading 2	.07	.26[a]	.19[b]	.14[d]	.06	.13[d]	.27[a]	.32[a]	.27[a]	1												
11. How much likes doing reading-related tasks at school 2	.11	.25[a]	.19[c]	.06	.00	.06	.21[b]	.27[a]	.25[a]	.75[a]	1											
12. How much likes doing reading-related tasks at home 2	.05	.16[c]	.12[d]	.06	.07	.09	.24[a]	.23[b]	.45[a]	.49[a]	.55[a]	1										
13. How much likes reading 4	.12[d]	.23[b]	.38[a]	.00	.04	.03	.08	.11	.07	.31[a]	.23[b]	.18[c]	1									
14. How much likes doing reading-related tasks at school 4	.04	.18[b]	.37[a]	.02	.03	.04	.07	.11	.05	.25[a]	.21[b]	.09	.77[a]	1								
15. How much likes doing reading-related tasks at home 4	.05	.24[b]	.32[a]	.00	.06	.06	.01	.11	.02	.28[a]	.24[b]	.19[b]	.55[a]	.58[a]	1							
16. How much likes Finnish 7	.10	.07	.20[b]	.47[a]	.47[a]	.43[a]	.20[b]	.19[c]	,05	.01	.05	.09	.08	.11	.15[c]	1						

17. How much likes to do tasks related to Finnish 7	.04	.07	.18[c]	.41[a]	.35[a]	.33[a]	.18[c]	.13[d]	.00	.04	.06	.06	.10	.11	.19[b]	.63[a]	1						
18. How good the student is at reading 1 (TE)	.44[a]	.43[a]	.40[a]	.28[a]	.32[a]	.19[b]	.11[d]	.01	.08	.05	.04	.05	.18[c]	.20[b]	.19[b]	.04	.01	1					
19. How good the student is at reading 2 (TE)	.39[a]	.48[a]	.44[a]	.33[a]	.31[a]	.14[d]	.05	.05	.07	.04	.13[c]	.03	.25[a]	.22[b]	.22[b]	.07	.02	.75[a]	1				
20. How good are studentds comrehensive skills 4 (TE)	.35[a]	.36[a]	.45[a]	.32[a]	.30[a]	.11	.00	.01	.00	.06	.00	.01	.31[a]	.25[a]	.20[b]	.10	.01	.62[a]	.68[a]	1			
21. How good are studentds techinal reading skills 4 (TE)	.38[a]	.34[a]	.45[a]	.32[a]	.32[a]	.12[d]	.00	.03	.00	.03	.02	.02	.29[a]	.25[a]	.23[a]	.19[b]	.12[d]	.62[a]	.68[a]	.84[a]	1		
22. Grade in mathematics 7	.22[b]	.11	.21[b]	.54[a]	.45[a]	.37[a]	.13[d]	.12	.10	.04	.05	.03	.09	.04	.08	.30[a]	.24[a]	.42[a]	.45[a]	.51[a]	.55[a]	1	
M	5.21	5.32	7.11	3.50	3.38	2.20	4.05	4.05	4.07	4.04	3.91	3.96	3.89	3.94	3.90	3.19	3.11	3.68	3.48	3.64	3.49	7.98	
SD	3.97	3.99	3.52	0.78	0.79	0.87	1.10	1.09	1.15	1.00	1.09	1.13	0.97	0.89	0.99	1.10	1.05	1.13	1.18	1.13	1.16	0.95	
Scale	1-20	1-20	1-20	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	4-10	

Note 1. TE = Teacher's evaluation

Note 2. [a] $p < .001$; [b] $p < .01$; [c] $p < .05$; [d] $p < .10$.

Note 3. The means and standard deviations for items 1-3 and 6 are the values before reversing the scale for the analysis.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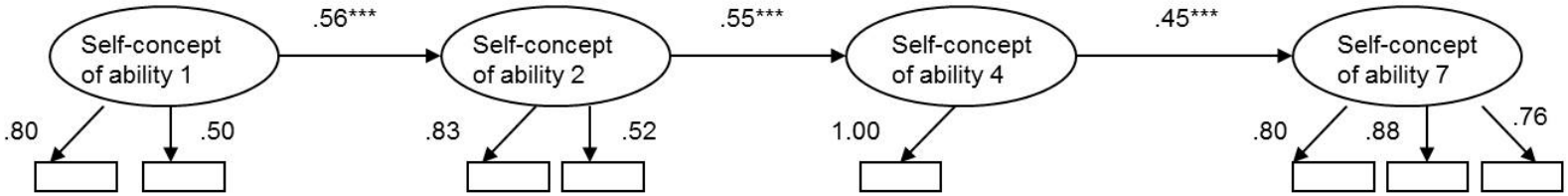
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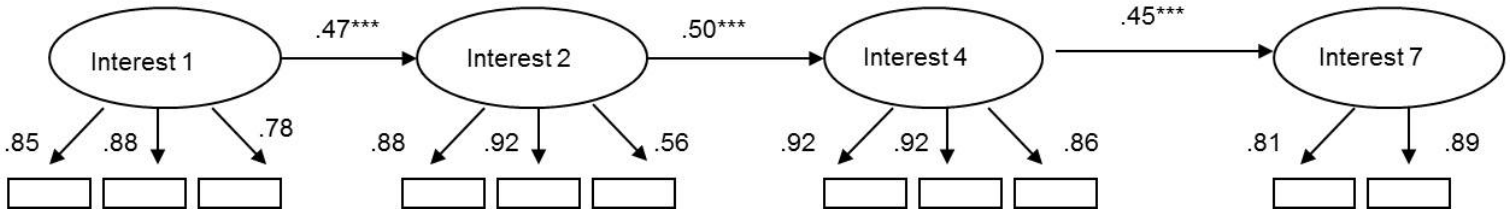
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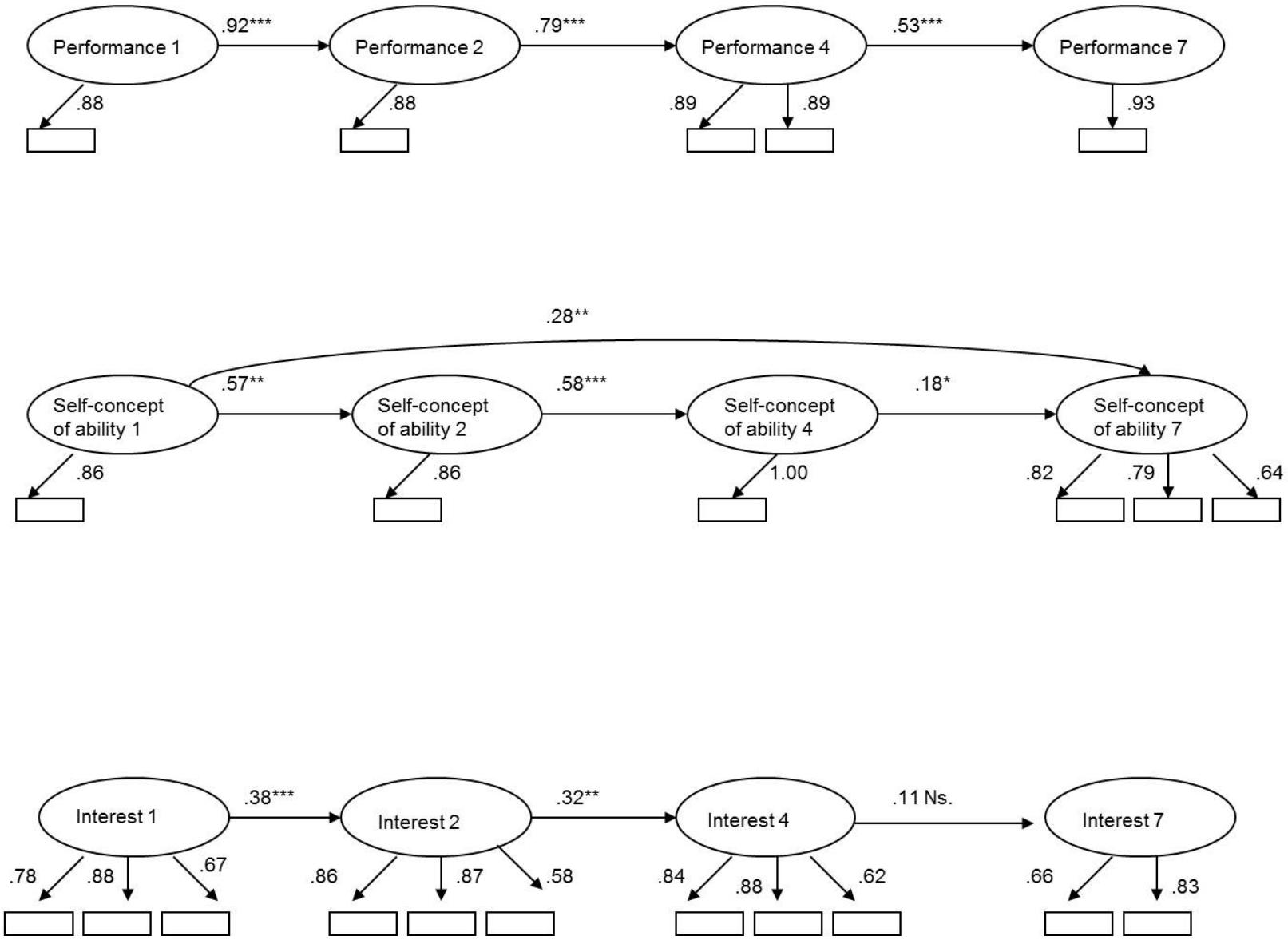
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Self-concept of ability 1
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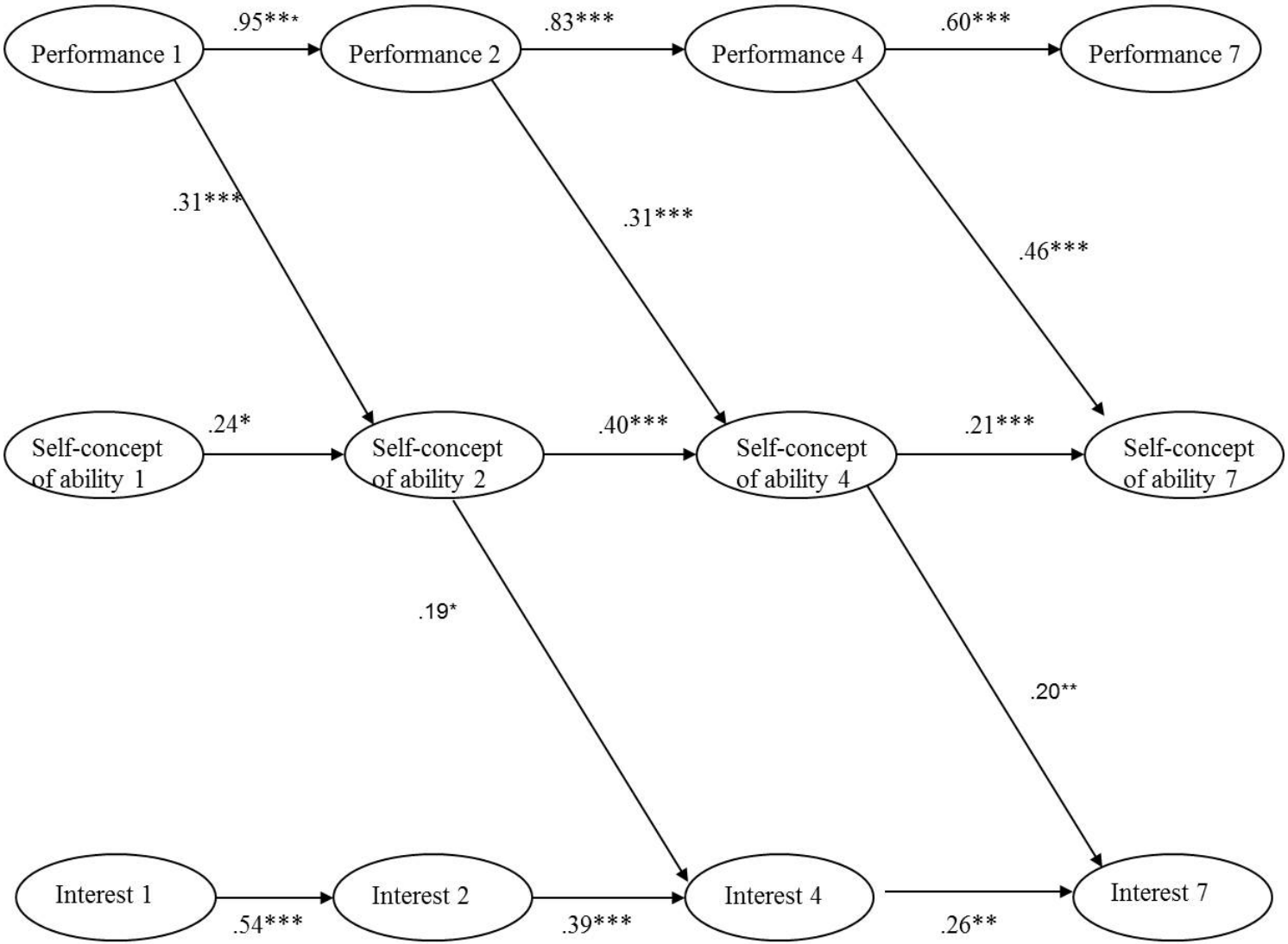
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Self-concept of ability 1
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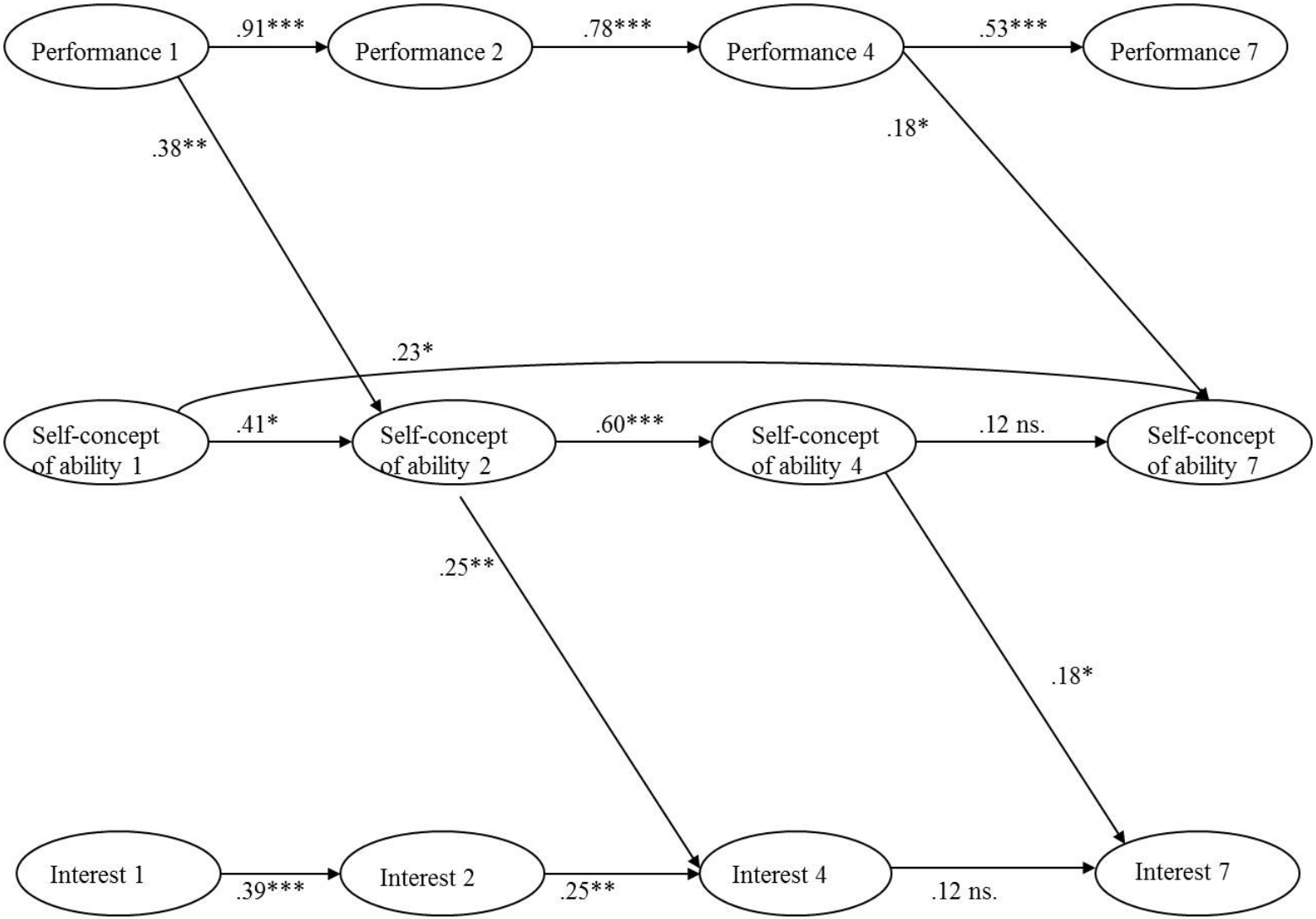
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