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The Developmental Dynamics of Task-Avoidant Behavior and Math Performance in

Kindergarten and Elementary School

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Abstract

Besides cognitive factors, children's learning at school may be influenced by more dynamic phenomena, such as motivation and achievement-related task-avoidant behavior. The present study examined the developmental dynamics of task-avoidant behavior and math performance from kindergarten to Grade 4. A total of 225 children were tested for their arithmetic skills in kindergarten and in Grades 1, 2, and 4 of elementary school. Children's task-avoidant behavior in learning situations was rated by their teachers. The results of latent growth curve analyses showed that math performance and task-avoidant behavior develop in tandem: an increase in task-avoidant behavior was related to less improvement in math performance. Furthermore, a high initial level of task-avoidant behavior predicted less improvement and slower improvement in math later on.

KEYWORDS: Elementary School, Kindergarten, Mathematics, Motivation, Task-Avoidant Behavior

The Developmental Dynamics of Task-Avoidant Behavior and Math Performance in

Kindergarten and Elementary School

1. Introduction

The importance of motivation and related classroom behavior in the development of academic skills is well recognized (Murphy & Alexander, 2000; Pintrich, 2003; Steinmayr & Spinath, 2009; Wigfield & Cambria, 2010). Children who are motivated and willing to make an effort are more likely to succeed in learning tasks (Onatsu-Arvilommi & Nurmi, 2000). In turn, children who are less motivated and reluctant to invest effort are more likely to fail in learning situations. Students' achievement-related beliefs and behaviors have been found to be related to their mathematical skills (e.g., Aunola, Nurmi, Lerkkanen, & Rasku-Puttonen, 2003; Kikas, Peets, Palu, & Afanasjev, 2009; Meece, Wigfield, & Eccles, 1990; Mägi, Häidkind, & Kikas, 2010; Onatsu-Arvilommi, Nurmi, & Aunola, 2002; Skaalvik, 1997). However, less research has been carried out on the extent to which previous achievement behaviors contribute to the development of students' math performance, and vice versa. Consequently, this study investigated whether children's achievement-related behaviors in the classroom (that is, their task-avoidant behavior) predict subsequent changes in their math performance, and whether their math performance predicts subsequent changes in their achievement-related behaviors.

1.1. Task-focused versus task-avoidant behaviors

Previous research has shown that positive achievement-related behaviors, such as task-focused behaviors, are associated with good academic outcomes, whereas negative behaviors like task-avoidant behaviors are related to poor academic outcomes (e.g., Aunola, Nurmi, Niemi, Lerkkanen, & Rasku-Puttonen, 2002; Aunola et al., 2003; Onatsu-Arvilommi et al., 2002; Manolitsis, Georgiou, Stephenson, & Parrila, 2009). Following the ideas of social cognitive theory and especially the role of efficacy beliefs in academic functioning

(Bandura, 1977, 1989; Schunk, 1981, 1989), achievement-related behaviors are thought to result from a multi-stage process (Aunola et al., 2002; Aunola et al., 2003; Cantor, 1990). Success in previous learning situations sets up a basis for a positive self-concept and beliefs of self-efficacy which then promote students' expectations of success concerning a particular learning task (Bandura, 1977, 1993). These expectations lead to increased motivation, effort, and task-relevant behavior in subsequent learning situations (Bandura, 1989, 1993; Schunk, 1981, 1989) which further provide a basis for successful learning. By contrast, negative self-concepts of ability and low efficacy beliefs, originating from repeated failures in previous learning situations, increase the likelihood of failure expectations. This then leads to low motivation, low effort, and task-avoidant or task-irrelevant behavior in later learning situations (e.g., Aunola et al., 2003; Bandura, 1989, 1993; Schunk, 1981), increasing the likelihood of failing in challenging learning tasks. Behaviors that are irrelevant or counter-productive to the situation can serve two kinds of coping purposes. Firstly, such behavior may provide an attributional excuse for the expected failure and help to buffer a positive self-concept (Jones & Berglas, 1978). Alternatively, avoidant behavior may serve as a coping strategy to help one reduce anxiety in situations that one assumes are a threat to one's feelings of self-worth or control (Miller, 1987).

In this study we use the concept of task-focused vs. task-avoidant behavior to refer to children's functional and dysfunctional patterns of behavior in the classroom. A variety of other conceptualizations have been used in the past to describe students' achievement-related beliefs, behaviors, and orientations. Adaptive behavioral patterns parallel to task-focused behavior are, e.g., mastery orientation (Diener & Dweck, 1978), task involvement (Nicholls, 1984), and task-involved orientation (Nicholls, Cheung, Lauer, & Patashnick, 1989). In contrast, task-avoidant behavior can be associated with maladaptive strategies, such as self-handicapping (Jones & Berglas, 1978), learned helplessness (Dweck, 1975), and defensive

pessimism (Martin, Marsh, & Debus, 2001). Furthermore, achievement goal orientation theory differentiates between mastery (or learning) and performance (or ego) orientations (e.g., Meece, Blumenfeld, & Hoyle, 1988; Midgley, Kaplan, & Middleton, 2001). These can be further divided into approach and avoidance components (Elliot & Harackiewicz, 1996; Skaalvik, 1997; Pintrich, 2000). Mastery approach and avoidance goals are generally related to better achievement, and are thus considered functional or adaptive (cf. task-focused behavior). Conversely, performance-avoidance orientation is generally associated with negative learning outcomes (cf. task-avoidant behavior). Findings concerning the benefits of performance-approach orientation are somewhat mixed (see Wigfield & Cambria, 2010).

1.2. Learning mathematics

Elementary school mathematics includes many sub-domains, such as numeration, measurement, arithmetic, algorithmic computation, and problem solving (Fuchs et al., 2006). Mastering these sub-domains requires the use of several mathematical skills, such as number sense, conceptual understanding, knowledge of arithmetic operations, mathematical logic or reasoning, and strategic prerequisites or procedural knowledge (Aunola, Leskinen, Lerkkanen, & Nurmi, 2004). In several studies mathematical skills have been found to relate to different antecedents, such as number sequence skills, listening comprehension, verbal skills, nonverbal problem solving, processing speed, attention, metacognitive skills, parents' educational level or socio-economic status, and parents' expectations and beliefs (Aunola et al., 2003; Aunola et al., 2004; Byrnes & Wasik, 2009; Entwisle & Alexander, 1990; Fuchs et al., 2006). Learning mathematics is also assumed to progress hierarchically: learning basic concepts and skills is necessary for understanding more complex skills (Aunola et al., 2004; Entwisle & Alexander, 1990; Fuchs et al., 2006). For example, arithmetic skills have been found to predict skill development both in algorithmic computation and arithmetic word problems (Fuchs et al., 2006). Mathematical skills have also been found to develop

cumulatively in the first grades of elementary school: inter-individual differences in mathematical skills grow over time, because children with good skills improve more than do children with poorer skills (Aunola et al., 2004; Kikas et al., 2009).

1.3. Task-avoidant behavior and math performance

It has been suggested that task-focused or task-oriented behavior plays an important role in the learning of academic skills (Aunola et al., 2002; Aunola et al., 2003; Onatsu-Arvilommi & Nurmi, 2000).The research in this field includes, however, at least four limitations. First, although task-focused or task-oriented behaviors have been found to be related to the development of literacy skills (e.g., Aunola et al., 2002; Georgiou, Manolitsis, Nurmi, & Parrila, 2010; Hirvonen, Georgiou, Lerkkanen, Aunola, & Nurmi, 2010; Manolitsis et al., 2009; Stephenson, Parrila, Georgiou, & Kirby, 2008), less research has been carried out on how they support the development of mathematical skills (for exceptions, see Kikas et al., 2009; Mägi et al., 2010; Onatsu-Arvilommi & Nurmi, 2000; Onatsu-Arvilommi et al., 2002). Second, although some of the previous studies have shown that achievement-related behaviors contribute to the development of mathematical skills (Kikas et al., 2009; Mägi et al., 2010; Onatsu-Arvilommi et al., 2002), less attention has been given to the possibility that previous levels of math performance may also influence subsequent behaviors in achievement situations. There are good reasons to assume that task-focused vs. task-avoidant tendencies evolve in learning situations, and are influenced by the feedback students get from their efforts to learn particular skills. Students who are doing poorly compared to others and receive negative feedback, are more likely to rely on task-avoidant patterns of behavior. The findings of the few studies that have considered the effect that math performance has on task-focused versus task-avoidant behavior have been mixed. For example, in one study Onatsu-Arvilommi and Nurmi (2000) found that poor mathematical skills increased children's later use of task-avoidant strategies as reported by their teachers, whereas in other studies math

skill development was not found to affect self-reported achievement beliefs and behaviors or teacher-rated task-focused behavior (Aunola et al., 2003; Onatsu-Arvilommi et al., 2002). Third, the findings of previous studies (Aunola et al., 2002; Onatsu-Arvilommi & Nurmi, 2000; Onatsu-Arvilommi et al., 2002) have relied on path models and cross-lagged associations between task-avoidant behavior and math performance, thus showing only that previous levels of one construct are related to the subsequent levels of the other construct. However, the changes of task-avoidant behavior and math performance across time and the associations between these changes have seldom been evaluated in the previous studies (for an exception, see Kikas et al., 2009).

In the present study, we have tried to increase our understanding of the developmental dynamics of achievement-related behaviors and students' math performance in the following ways: we used cross-lagged longitudinal data spanning five years, from kindergarten to grade 4; we examined the developmental dynamics of children's math performance and their task-avoidant behavior in the classroom context; we used teacher-ratings of children's classroom behavior; and we used latent growth curve modeling that provided us an opportunity to examine the extent to which levels of and changes in task avoidance and math performance are related to each other.

1.4. Finnish kindergarten and school curricula

Before entering elementary school, a large majority of Finnish children (99.4% of 6 year-olds in 2009; National Board of Education, 2010) attend a one-year kindergarten, which they begin in the year of their 6th birthday. Kindergarten education is free of charge, and it is usually organized by local day-care centre or elementary school. In kindergarten, there is no formal teaching of academic skills, such as numeracy. Instead, children are introduced to numbers, mathematical concepts, quantities, shapes, and the basics of classification,

comparison, and sorting in the form of nursery rhymes and games (National Board of Education, 2000).

In the year of their 7th birthday children enter Grade 1 of elementary school. In Grades 1 and 2 the task of instruction in mathematics is to support the learning of mathematical concepts and the development of mathematical thinking (National Board of Education, 2004). Students learn to use numbers as symbols of amount and order, to apply addition, subtraction, multiplication, and division operations, to explain and justify their conclusions, to perform comparisons or classify things, to know the decimal system and simple fractions, and to recognise basic geometrical forms. In Grades 3 to 5 students widen their knowledge of decimal system, geometry, number sequences, comparison, and the application of mathematical concepts and operations in real-world situations (National Board of Education, 2004). They learn how to present mathematical problems in writing and orally, to calculate the area and perimeter of simple forms, and to understand the basics of statistics and probability.

1.5. The role of gender and the parents

Previous research has reported gender differences in students' attitudes and their approach to school work (e.g., Byrnes & Wasik, 2009; Klapp Lekholm & Cliffordson, 2009; Onatsu-Arvilommi & Nurmi, 2000) and to mathematics in particular (e.g., Chouinard, Karsenti, & Roy, 2007; Kenney-Benson, Pomerantz, Ryan, & Patrick, 2006), with girls showing more task-oriented behavior, effort, and persistence than boys. Researchers have also found that although girls receive higher grades in mathematics at school (Kenney-Benson et al., 2006; Klapp Lekholm & Cliffordson, 2009), there are no gender differences in standardized test performances (Byrnes & Wasik, 2009; Herbert & Stipek, 2005; Kenney-Benson et al., 2006). Consequently, in the present study we used multi-sample procedures to

examine gender differences in the relationship between mathematical skills and task-avoidant behavior.

As both parents' level of education and their teaching of mathematics to their children were assumed to have an impact on children's mathematical skills (Blevins-Knabe & Musun-Miller, 1996; Huntsinger, Jose, Larson, Balsink Krieg, & Shaligram, 2000; LeFevre, Clarke, & Stringer, 2002) and on their task-avoidant behavior (Hokoda & Fincham, 1995; Salonen, Lepola, & Vauras, 2007), we controlled these variables in the analyses we performed. When helping and supporting their children in their learning, parents explicitly and implicitly provide persuasory information to their children and teach them to cope with difficulties in learning. These affect the children's self-efficacy perceptions and achievement behaviors (Bandura, 1993; Schunk, 1989; Schunk & Pajares, 2005).

1.6. The present study

The aim of the present study was to examine the developmental dynamics of children's math performance and their task-avoidant behavior from kindergarten to Grade 4. The following research questions were examined:

(1) Do children's math performance and task-avoidant behavior change (at the mean level) from kindergarten to Grade 4? We assumed that math performance would increase over time as children's skills develop (e.g., Aunola et al., 2004; Kikas et al., 2009). However, we did not set a hypothesis for task avoidance because there was no previous evidence of the changes in task-avoidant behaviors over time.

(2) To what extent the initial levels of and changes in children's task-avoidant behavior and math performance are associated? Following the earlier findings of the relationship between task avoidance and academic skills (e.g., Aunola et al., 2002; Onatsu-Arvilommi & Nurmi, 2000), we expected both the levels of and changes in task-avoidant behavior and math performance to be negatively associated.

(3) To what extent the initial level of children's task-avoidant behavior predicts changes in their math performance? We expected that a high level of task-avoidance would predict a slower increase in math performance, because previous studies have shown that maladaptive achievement behaviors are related to low levels of math performance later on (e.g., Kikas et al., 2009; Mägi et al., 2010; Onatsu-Arvilommi et al., 2002).

(4) To what extent the initial level of children's math performance predicts changes in their task-avoidant behavior? We assumed that a high level of math performance would contribute to a subsequent decrease in task avoidance, as positive learning experiences can be expected to lead to increased motivation and a smaller degree of task-irrelevant behavior (e.g., Onatsu-Arvilommi & Nurmi, 2000).

2. Method

2.1. Participants

2.1.1. Children

A total of 225 children (107 girls and 118 boys) participated in the study, which was part of an extensive (names of the authors removed for reviewing purposes) study. The study focuses on the development of literacy, numeracy, and learning motivation in kindergarten and elementary school. The target sample consisted of all the children residing in two medium-sized districts of Central Finland who were born in 1993 and started kindergarten in 1999. At the first set of assessments, in kindergarten, the children were 6 to 7 years of age (M = 81.0 months, SD = 3.3).

The children were examined four times: in the spring of kindergarten (April 2000; N = 205), in the spring of Grade 1 (April 2001, N = 216), in the spring of Grade 2 (March 2002, N = 224), and in the spring of Grade 4 (April 2004, N = 227). The number of participants grew from one assessment to the next because new children were included in the study when

they moved to the municipalities and joined the classes that were taking part in the study. A total of 182 children (72.8 %) participated in all four measurements, 33 (13.2 %) in three measurements, 10 (4.0 %) in two measurements, and 25 (10.0 %) in one of the four measurements. Two hundred and twenty-five children participated in at least two measurements.

When the children who participated in three or less measurements were compared to those who participated in all four measurements, the results showed that the children who did not participate in all of the measurements showed less task-avoidant behavior in Grade 1 ($t(214) = -2.40$, $p < .05$) and in Grade 2 ($t(218) = -3.39$, $p < .01$) than the children who were followed throughout the study. There were no other differences between these two groups of participants in terms of their task-avoidant behavior and math performance (all ps > .13) or their parents' educational level and the teaching of mathematics in kindergarten (all ps > .13).

The parents' consent was sought for their children's participation in this study. At each time point, the children's performance in mathematics was tested and their teachers rated them for task-avoidant behavior. Originally the children were recruited from 21 kindergarten groups. In Grade 1 the children came from 17 classes, and in Grades 2 and 4 from 18 classes.

2.1.2. Parents

Both the mother and the father of each child were sent a questionnaire in December of their child's kindergarten year. The parents were asked to complete the questionnaires independently without discussing the topics with each other. A total of 187 mothers (91.2 %) and 164 fathers (80.0 %) filled in and returned the questionnaires. At the time of the study, 156 mothers (83.4 %) lived in a household of two parents and children, 18 mothers (9.6 %) lived with a new spouse and their children, and 13 mothers (7.0 %) were single parents. A total of 143 fathers (87.2 %) lived in a household of two parents and children, and 15 (9.1 %)

lived with a new spouse and children. None of the fathers reported being a single father and 6 (3.7 %) gave no answer to the question concerning their living arrangements.

2.2. Measures

2.2.1. Math performance

In the spring of kindergarten, Grade 1, and Grade 2, the children's math performance was assessed using the Diagnostic Test for Basic Mathematical Concepts (Ikäheimo, 1996). The test consists of five subtests assessing different subskills, including knowledge of ordinal numbers, knowledge of cardinal numbers and basic mathematical concepts, number identification, word problems, and basic arithmetic. To keep our measures as consistent and comparable as possible across different measurements, we decided to use only the basic arithmetic subtest of the Diagnostic Test. The tasks were presented to the children on a sheet of paper, and the children answered with a pencil. The test was not timed. The tasks combined arithmetic items and algorithmic computation problems, including addition (e.g., "8 + 6 = __"), subtraction (e.g., "11 – 2 = __"), and in Grade 2 also multiplication (e.g., "8 x 7 = __"), and division (e.g., "48 / 6 = __"). To avoid a ceiling effect, new items with increasing difficulty were added to the test at each subsequent measurement. One point was given for each correct answer. The maximum scores in the test in kindergarten, Grade 1, and Grade 2 were 8, 28, and 42, respectively. The test-retest correlation for the tasks was .45 from kindergarten to Grade 1, and .72 from Grade 1 to Grade 2. The score in the basic arithmetic subtest correlated with the score in the whole Diagnostic Test with .74 in kindergarten, .96 in Grade 1, and .99 in Grade 2, which implies that the basic arithmetic subtest gives a good estimate of the child's overall mathematical ability.

In the spring of Grade 4, children's math performance was assessed with a slightly different set of arithmetic and algorithmic computation problems. Of the previously used 42 items, 14 were dropped because all the participating children correctly responded on these

already during the previous measurement point. The remaining 28 items were extended with 18 new and more advanced items to correspond to the children's improved skills. One point was given for each correct answer, and the maximum score in the test was 46. However, to enable the use of growth curve modeling across all measurement points, 14 points from the dropped items were later added to each participant's score, thus giving a maximum score of 60. The test was presented to the children on a sheet of paper, and it was not timed. The test items included addition (e.g., "527 + 31 = __"), subtraction (e.g., "485 – 42 = __"), multiplication (e.g., "8 x 7 = __"), and division (e.g., "48 / 6 = __"). The test scores correlated with the kindergarten, Grade 1, and Grade 2 test scores with .44, .59, and .71, respectively. The test scores also correlated .60 with the teacher's evaluation of the child's mechanical numeracy skills and .67 with the teacher's evaluation of the child's applied numeracy skills in Grade 4.

2.2.2. Teacher ratings of task-avoidant behavior

The participants' kindergarten and elementary school teachers were asked to rate the behavior of each child using the Behavioral Strategy Rating Scale (BSR; Onatsu & Nurmi, 1995). They were asked to consider how a certain child typically behaved in different situations in kindergarten and then to rate his or her behavior using five statements (*When facing difficulties, does the student have a tendency to find something else to do instead of focusing on the task in hand? Does the student actively attempt to solve even difficult situations and tasks* [reverse coded]*? Does the student give up easily? Does the student show persistence in his/her activities and tasks* [reverse coded]*? If the activity is not going well, does the student lose his/her focus and turn his/her attention to other things?*). The statements were assessed on a 5-point scale (1 = *not at all*, 5 = *to a great extent*). A composite score for the children's task-avoidant strategy was created by computing a mean of the five teacher-rated items. Cronbach's alpha reliability coefficient for the teachers'

evaluations in kindergarten and in Grades 1, 2, and 4 was .91, .96, .97, and .91, respectively. Teachers' ratings of task-focused versus task-avoidant behavior have been shown to correlate moderately with children's self-reported task-focused versus task-avoidant behavior (.30) (authors removed for reviewing purposes, 2000; authors removed for reviewing purposes, 1997) and also with observers' ratings of it (.42) (authors removed for reviewing purposes, 2000).

2.2.3. Parents' education

Parents' level of education was obtained by asking parents to choose between four options: 1 = *no vocational degree [e.g., a sales clerk or a driver]*; 2 = *vocational school degree [e.g., a cleaner or a plumber]*; 3 = *technical college degree [e.g., a nurse or a sales manager]*; 4 = *university or college degree [e.g., a school teacher or a lawyer]*.

2.2.4. Parents' teaching of mathematics

Parents were also asked to report the frequency of the help they had given their child in math-related tasks in kindergarten. They were asked to answer two questions (*How often have you taught your child to recognize numbers? How often have you taught your child to solve simple math problems?*) on a 4-point scale (1 = *not at all*, 2 = *occasionally*, 3 = *once or twice a week*, 4 = *several times a week*). A composite score for the parents' teaching of mathematics was created by computing a mean of the two items. Cronbach's alpha reliability coefficient for the parents' responses was .81 for the mothers and .78 for the fathers.

2.3. Procedure

The tests were administered by trained research assistants. In kindergarten the tasks were carried out in a one-to-one test, i.e. with only the child and the assistant present. In Grades 1, 2 and 4 children's math performance was assessed in groups of 2 to 12 children. The tests took place in a suitable room in the kindergarten or on the school premises during the school day.

2.4. Statistical analyses

To examine the developmental dynamics between task-avoidant behavior and math performance we used latent growth curve modeling (LGM; Muthén & Khoo, 1998). LGM modeling allowed us to examine the nature of the growth trajectories of both constructs (first research question), as well as the associations between the different growth components (second, third, and fourth research questions). Three growth components were estimated for both constructs: the intercept (level), the linear growth rate (slope), and the quadratic growth rate (quadratic trend). For the intercept factor, factor loadings of the observed variables were fixed to 1 for each measurement point. For the linear growth factor the factor loadings were fixed to correspond to a linear time scale (i.e., 0, 1, 2, and 4). For the quadratic growth factor the loadings were fixed to 0, 1, 4, and 16.

All analyses were performed using the Mplus 5.21 statistical program (Muthén & Muthén, 1998-2007). Maximum likelihood estimation with robust standard errors (MLR) was used at each step of the analyses. To evaluate model fit, we used chi-square values, the comparative fit index (CFI), the Tucker-Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). The cutoff values used in the evaluation of model fit were .95 for CFI and TLI, .06 for RMSEA, and .08 for SRMR (Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004). The Satorra-Bentler formula was used to calculate the corrected value of chi square difference test for nested models.

3. Results

3.1. Descriptive statistics

Means and standard deviations for all of the measures and the correlations between them are presented in Table 1, separately for girls and boys. There were significant gender differences in the means of task-avoidant behavior, with boys showing more task avoidance

than girls at every level: in kindergarten ($t(197) = 4.62$, $p < .001$), Grade 1 ($t(214) = 3.83$, $p < .001$), Grade 2 ($t(218) = 5.91$, $p < .001$), and Grade 4 ($t(225) = 4.63$, $p < .001$). There were no gender differences in math performance or parental measures.

-- INSERT TABLE 1 AROUND HERE --

3.2. Latent growth curve analyses

Our first research question concerned whether children's math performance and task-avoidant behavior change from kindergarten to Grade 4. To examine this, separate LGM models were carried out for math performance and task-avoidant behavior. For both constructs, a model including the initial level, linear growth, and quadratic growth components fitted the data best. In the models, paths from the initial level to the linear and quadratic growth factors were estimated, as well as paths from the linear growth to the quadratic growth factor. Because the residual variances of math performance in kindergarten and task-avoidant behavior in Grade 4 were negative, these parameters were fixed to 0. Furthermore, all non-significant paths between the latent growth components were fixed to 0. The model fit indices and estimated parameters for both models are presented in Table 2.

-- INSERT TABLE 2 AROUND HERE --

The results for math performance showed that the means of the linear (α_2) and quadratic growth (α_3) components were positive and statistically significant ($ps < .001$), indicating that there was an increase in math performance over time and this increase accelerated. The results also showed that the variances of the level (ψ_{11}, $p = .048$) and linear growth (ψ_{22}, $p < .001$) components were statistically significant, indicating inter-individual differences in the initial level of math performance and in the subsequent increase in math performance. The variance of the quadratic growth (ψ_{33}) was not statistically significant. Furthermore, the results showed that the path from the level to the linear trend (ψ_{21}) of math performance was positive and statistically significant ($p = .004$), indicating that the higher the

initial level of performance, the better the improvement in performance. The path from the linear trend to the quadratic trend (ψ_{32}) was negative and statistically significant ($p < .001$), indicating that the more math performance improved across time, the more the growth decelerated later on.

The mean of the linear (α_2) growth for task-avoidant behavior was not statistically significant ($p = .53$). However, the mean of the quadratic growth (α_3) was positive and statistically significant ($p = .001$), indicating that the changes in task-avoidant behavior accelerated across time. The variances of the three growth components of task avoidance were positive and statistically significant: there were inter-individual differences in the initial level (ψ_{11}, $p < .001$), in the linear growth rate (ψ_{22}, $p < .001$), and in the acceleration of the growth (ψ_{33}, $p < .001$). The results further showed that the path from the initial level to the linear trend (ψ_{21}) was not statistically significant. However, the paths from the initial level (ψ_{31}, $p = .008$) and from the linear trend (ψ_{32}, $p < .001$) to the quadratic trend were negative and statistically significant, indicating that the higher the initial level of and the more increase in task avoidance, the more deceleration there was across time.

Our second, third, and fourth research questions concerned the associations between the initial levels of and changes in children's task-avoidant behavior and math performance. To answer these questions, a multivariate latent growth curve model was conducted to examine the growth components of math performance and task-avoidant behavior simultaneously. Three growth components were estimated for both constructs: initial level, slope, and quadratic trend. Moreover, the covariances between the levels of math performance and task-avoidant behavior, between the linear trends of math performance and task-avoidant behavior, and between the quadratic trends of math performance and task-avoidant behavior were estimated. The associations from the levels of math performance and task-avoidant behavior to the linear and quadratic trends, and from the linear trends of both

constructs to the quadratic trends were estimated as regression coefficients. Because the residual variances of math performance in kindergarten and task-avoidant behavior in Grade 4 were negative, these parameters were fixed to 0. Furthermore, all non-significant covariances and paths between the latent growth components were fixed to 0. The fit of the final model was good ($\chi^2(20) = 26.15$, $p = .16$; *CFI* = .99; *TLI* = .99; *RMSEA* = .04; *SRMR* = .03). The results of the final model are presented in Figure 1.

-- INSERT FIGURE 1 AROUND HERE --

As a result to our second research question concerning the association between the initial levels of and changes in children's task-avoidant behavior and math performance, we found that the covariance between the level of math performance and the level of task avoidance was negative and statistically significant, as was the relationship between the linear trend of math performance and the linear trend of task avoidance. These results indicate that the higher the math performance, the lower the level of task-avoidant behavior, and vice versa. Furthermore, the more increase in task-avoidant behavior, the less improvement in math performance, and vice versa.

The last two research questions concerned whether the initial level of children's task-avoidant behavior would predict changes in their math performance, and whether the initial level of children's math performance would predict changes in their task-avoidant behavior. The results showed that the level of task-avoidant behavior negatively predicted the linear and quadratic trends of math performance: the higher the initial level of task avoidance, the less and the slower the improvement in math later on. However, in respect to the last research question, we found that the level of math performance did not predict the linear or quadratic trends of task avoidance.

Next, we were interested in investigating whether the parents' level of education and their teaching of mathematics to their children influenced the relationship between children's

task-avoidant behavior and their math performance. Consequently, mother's level of education, mother's teaching of mathematics, father's level of education, and father's teaching of mathematics were added into the previous model as covariates. The results showed that the previously found associations between the six growth components remained similar after controlling for these background variables.

Finally, to test if the same model fitted for girls and boys, we conducted a multi-sample analysis. This was done by first creating a non-restricted model, and comparing the fit of this model to another model that was fully restricted across gender. In the fully restricted model the means and the variances of the six growth components as well as the associations between these components were constrained equal across gender. The chi-square likelihood ratio test between the non-restricted and the restricted models suggested there were gender differences in the model ($\Delta\chi^2 = 65.55$, $\Delta df = 18$, $p < .001$). Freeing the estimates for the mean of the level of task-avoidant behavior and the mean of the linear growth of math performance resulted in a model that no longer differed significantly from the non-restricted model ($\Delta\chi^2 = 19.85$, $\Delta df = 16$, $p = .23$). The fit of this final model was acceptable ($\chi^2(57) = 68.61$, $p = .12$; $CFI = .98$; $TLI = .98$; $RMSEA = .04$; $SRMR = .14$). The results showed that for boys ($M = 2.72$, $SE = 0.08$, $p < .001$) the level of task-avoidant behavior was higher than for girls ($M = 2.14$, $SE = 0.08$, $p < .001$), and for boys ($M = 22.89$, $SE = 1.99$, $p < .001$) the linear growth in math was steeper than for girls ($M = 19.41$, $SE = 1.56$, $p < .001$). All other parameter estimates were equal for boys and girls.

4. Discussion

The aim of the present study was to examine the developmental dynamics of children's math performance and task-avoidant behavior from kindergarten to Grade 4. The results revealed that the development of math performance was affected by children's task-avoidant behavior: the more task avoidance children initially showed, the less their math

performance improved and the slower the improvement was later on. The results showed further that the development of mathematical skills and task-avoidant behavior go hand in hand: the better the children performed in math, the less task-avoidant behavior they showed, and the more the children improved in math, the more their task avoidance decreased.

The major finding of the present study was that task-avoidant behavior, or the lack of it, plays an important role in the development of mathematical skills: a high initial level of task-avoidant behavior predicted less and slower improvement in math performance. This finding parallels findings from some previous studies (Aunola et al., 2003; Kikas et al., 2009; Onatsu-Arvilommi et al., 2002) showing the importance of task-avoidant and task-focused behaviors in the learning of mathematics. These results are also similar to those found for reading: task-focused or task-oriented behaviors have been found to predict the development of literacy skills (e.g., Aunola et al., 2002; Georgiou et al., 2010; Hirvonen et al., 2010; Manolitsis et al., 2009; Stephenson et al., 2008). Overall, these results suggest that lack of motivation, effort, and persistence in the classroom is an obvious risk for problems in skill development since it reduces the extent to which the student uses his or her existing skills, tries out and practices new skills, and finds the relevant situational cues for his or her learning (Meece et al., 1988; Pintrich & de Groot, 1990). It has also been suggested that task-avoidant behaviors are related to feelings of anxiety (Miller, 1987), which are particularly detrimental for learning mathematics (Elliot & McGregor, 1999; Pintrich & de Groot, 1990; Wigfield & Meece, 1988).

However, the present study failed to confirm an opposite direction of the relationship: the initial level of math performance was not related to subsequent changes in task avoidance. This is a similar finding to those of Aunola and colleagues (2003) and Onatsu-Arvilommi and colleagues (2002), but is contrary to the findings that have been found in relation to literacy skills (e.g., Aunola et al., 2002; Hirvonen et al., 2010; Onatsu-Arvilommi & Nurmi, 2000).

One possible reason for the different findings in math and reading is that students' achievement-related beliefs and behaviors may be less sensitive to math learning experiences than to experiences in literacy learning. Since learning to read and write are basic skills that influence also other school subjects, problems in these skills may be more detrimental for students' achievement-related beliefs and behaviors, whereas problems in math may be limited to that domain only and do not reflect on the students' general beliefs and behaviors in achievement situations.

The results of the present study showed, however, that math performance and task avoidance develop in tandem: an increase in math performance across time was associated with a decrease in task avoidance. This finding suggests that although performance in math cannot be considered as an antecedent of task- avoidant behavior, improvement of math skills and decrease in task-avoidant behaviors go hand in hand, and can be based on the cumulative cycles between two phenomena (Aunola et al., 2003; Onatsu-Arvilommi & Nurmi, 2000). Consequently, there is an evident need for future studies on the cross-lagged relations between these two constructs. Overall, the results of the present study are in accordance with theories of competence perceptions and academic functioning. Negative self-concepts of ability and low efficacy beliefs, originating from repeated failures and negative feedback in previous learning situations, are likely to lead to failure expectations, low motivation, low effort, and task-avoidant or task-irrelevant behavior in later learning situations (e.g., Aunola et al., 2003; Bandura, 1993; Schunk, 1989; Schunk & Pajares, 2005), consequently increasing the likelihood of failing in challenging learning tasks.

The results showed further that gender was related to the level of task-avoidant behavior and the linear growth of math performance, boys showing higher levels of task avoidance and a steeper growth in mathematical skills. However, gender did not affect the associations between task-avoidant behavior and math performance. This means that the

effect of task avoidance on the development of mathematical skills did not depend on the gender of the child. Moreover, controlling for parents' level of education and teaching of mathematics to their children in kindergarten did not change the relations between math performance and task-avoidant behavior. This means that task-avoidant behavior had an impact on the development of mathematical skills, regardless of the education of the parents or the amount of teaching they had given their children in kindergarten.

Concerning the changes in task avoidance from kindergarten to Grade 4, the results of our study showed that although there were no linear changes at the mean level, the increase in task-avoidance behavior accelerated across time. The results showed further that there were individual differences in the changes of task avoidance. This suggests that person-oriented approaches could bring more insight into the individual growth trajectories. Not surprisingly, the results also revealed that there was an increase at the mean level of math performance, and this increase was accelerating. In addition, there were signs of cumulative development of math performance: the higher the initial level of performance, the steeper the improvement of it. This parallels earlier findings on numeracy learning (Aunola et al., 2004; Kikas et al., 2009).

The present study showing that task-avoidant behavior and mathematical skills develop in tandem also has some practical implications. In biggest danger of facing problems in learning seem to be the students who have developed maladaptive patterns of achievement behaviors, such as task avoidance, because they fall behind their classmates in skill development. Thus, there is an evident need to pay attention to what kinds of interventions could be employed with the students showing such maladaptive patterns. For example, it is important to pay attention to the beliefs that students have about their capabilities, because low efficacy beliefs and expectations of failure are likely to result in a low level of effort and a high level of task-avoidant behavior (e.g., Bandura, 1989; Pajares, 1996; Schunk, 1989;

Wigfield & Eccles, 2000). Students' efficacy perceptions are supported when they realize their knowledge has developed and they have learned something they did not know or could not do before (Bandura, 1993). Consequently, students should be provided opportunities to utilize their previous knowledge and skills, practice new skills, and feel competent (Pajares, 1996; Schunk & Pajares, 2005). Students should also learn to evaluate their performance in relation to their previous performances and skills, instead of normative or social comparison to their peers (Bandura, 1993; Pintrich, 2003). In learning situations the atmosphere should be maintained mastery oriented, i.e., the focus should be on understanding the materials and developing the knowledge and skills that are needed to master the tasks. Students have been shown to use more adaptive achievement strategies in classrooms where the atmosphere and teacher's practices are mastery oriented (Meece et al., 1988; Midgley et al., 2001). In contrast, when the classroom structure promotes competition, comparison, and grading, students are more likely to concentrate on performing better than the others or achieving the highest grade instead of focusing on effort, improvement, and mastering and enjoying the task (Urdan, Midgley, & Anderman, 1998). Moreover, students should learn to perceive learning as a process in which previous knowledge and skills help in gaining new ones (Schunk, 1989), and as a process that the students can themselves affect with their own actions (Pintrich, 2003). Students showing task-avoidant behavior in achievement situations can be helped to understand how focusing on tasks helps in their performance and how avoiding tasks harms it. Especially the youngest students may need feedback from their parents and teachers to recognize their capabilities and to understand how their own actions affect the process of their learning (Schunk & Pajares, 2005). It has been also found that as early as in kindergarten children show less task avoidance in classrooms where the teacher provides them individualized feedback and scaffolding (Pakarinen et al., 2011). Also students who sabotage their performance by engaging in task-irrelevant thoughts and behaviors because

they are anxious and concerned about their performance (Bandura, 1989; Pajares, 1996; Schunk & Pajares, 2005), may benefit from intervention in which they learn to assess their own abilities and the task requirements realistically and piece by piece (see Schunk & Pajares, 2005). When the task is being processed in smaller portions, it may not feel as overwhelming anymore.

There are at least three limitations that need to be considered when generalizing the findings of this study. First, children's task-avoidant behavior was measured by teacher ratings only. We cannot be certain whether the teachers' ratings were influenced by other factors, such as the gender, skill level, or personality of the child. In future multiple informants, such as classroom observers, teachers, and the children themselves should be asked to rate children's achievement-related beliefs and behaviors. Using multiple measures of achievement behaviors is important also for another reason. Task-avoidant (or task-focused) behavior may be the end product of various different patterns of attributions, beliefs, goals, decisions, and choices. Two students who engage in seemingly the same kind of behaviors may do so for very different reasons (see Pintrich, 2000). It is important to use different measures to capture the beliefs about competence, success, ability, and effort that lead to the actual behavior of the student. Second, slightly different sets of arithmetic and algorithmic computation tasks were used to measure children's math performance at different times of assessment. However, the basis and the format of the tasks remained the same throughout the study, although more demanding tasks were added to the previous ones as the children grew older. This is a common procedure to avoid a ceiling effect. Third, we used only arithmetic and algorithmic computation tasks to measure children's math performance. Previously, it has been found that the importance of task-focused behavior in literacy learning varies between tasks (e.g., reading fluency vs. spelling), depending on the difficulty or the complexity of the task (Georgiou et al., 2010; Hirvonen et al., 2010). Consequently,

comparing the effect of task-avoidant behavior on a wider range of numeracy skills, using tasks to test number sequence skills, knowledge of mathematical concepts and ability to solve word problems, for example, could lead to results that would give us more insights to the topic of the present study.

The findings of the present study revealed that children's task-avoidant behavior in the classroom can be detrimental for the development of their mathematical skills: children's use of task-avoidant strategies led to less improvement and to a slower rate of improvement in their subsequent math performance.

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Figure captions

Figure 1. Multivariate latent growth curve model for math performance and task-avoidant behavior. The figure presents standardized estimates.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 1

Summary of Intercorrelations, Means, and Standard Deviations of All Measures for Girls and Boys

Measure	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	*M*	*SD*
1. TAB Kindergarten		-.21*	.50**	-.22*	.42**	-.29**	.46**	-.20	.05	-.04	-.07	.02	2.12	0.96
2. Math Kindergarten	-.37**		-.24*	.43**	-.17	.47**	-.23*	.36**	.11	.21	.17	.13	2.55	2.23
3. TAB Grade 1	.56**	-.27**		-.24*	.69**	-.35**	.41**	-29**	-.11	-.13	.15	.11	2.05	1.01
4. Math Grade 1	-.40**	.48**	-.51**		-.26*	.73**	-.25*	.52**	.37**	.34**	-.11	-.23*	13.96	5.23
5. TAB Grade 2	.42**	-.19	.71**	-.52**		-.41**	.55**	-.37**	-.02	-.14	.09	-.00	1.94	0.90
6. Math Grade 2	-.40**	.46**	-.49**	.71**	-.52**		-.42**	.65**	.30**	.32**	-.01	-.20	25.98	7.56
7. TAB Grade 4	.44**	-.32**	.55**	-.45**	.66**	-.38**		-.43**	-.14	-.21	-.08	-.07	2.23	0.87
8. Math Grade 4	-.44**	.50**	-.53**	.63**	-.50**	.75**	-.48**		.37**	.19	.07	-.06	46.93	6.38
9. Mother's Education	-.15	.13	-.32**	.27*	-.28**	.26*	-.29**	.45**		.50**	-.07	-.07	2.66	0.93
10. Father's Education	-.13	.15	-.15	.33**	-.25*	.27*	-.39**	.36**	.53**		-.14	.02	2.49	0.90
11. Mother's Teaching	-.04	.04	.07	.08	.05	.03	.05	-.14	-.19	-.16		.37**	2.41	0.78
12. Father's Teaching	-.01	-.12	-.16	.19	-.06	.11	.14	.01	-.09	-.09	.23*		2.49	0.75
M	2.76	2.17	2.62	14.29	2.80	26.28	2.80	46.20	2.67	2.53	2.41	2.31		
SD	0.98	1.97	1.19	6.67	1.23	8.29	0.98	7.22	0.93	0.84	0.75	0.61		

Table 2

Estimated Latent Growth Curve Models for Math Performance and Task Avoidance,

Unstandardized Solutions (Standard Errors in Parentheses)

Parameter	Math Performance	Task Avoidance
α_1	2.377 (0.143)	2.440 (0.069)
α_2	11.248 (0.552)	-0.042 (0.067)
α_3	2.175 (0.117)	0.045 (0.014)
ψ_{11}	4.345 (0.454)	0.644 (0.085)
ψ_{22}	24.754 (3.041)	0.471 (0.088)
ψ_{33}	0.085 (0.222)	0.002 (0.000)
β_{21}	0.487 (0.167)	0^a
β_{31}	0^a	-0.016 (0.006)
β_{32}	-0.203 (0.009)	-0.229 (0.008)
θ_1	0^a	0.363 (0.072)
θ_2	12.734 (1.640)	0.412 (0.055)
θ_3	12.849 (2.815)	0.240 (0.061)
θ_4	2.886 (13.654)	0^a
	$\chi^2(3) = 5.042, p = .169$	$\chi^2(3) = 3.617, p = .306$
	RMSEA = .052, p = .389	RMSEA = .029, p = .548
	CFI = 0.995	CFI = 0.998
	TLI = 0.990	TLI = 0.996
	SRMR = .021	SRMR = .021

Note. α_1–α_3 = estimated mean values of the latent growth factors; ψ_{11}–ψ_{32} = variances of the latent growth factors; β_{21}–β_{32} = regression paths between the latent growth factors; θ_1–θ_4 = residual variances of the observed variables at different measurement points.

[a] = fixed.