Mathematics Related Self-Efficacy Beliefs and Task-Motivation and Associations with Mathematics Fluency Development: A Longitudinal Study of Children from 1st Grade to 2nd Grade

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ABSTRACT

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There is evidence that self-efficacy and task-motivation in mathematics play a crucial role in regulating mathematical performance. The purpose of this Master's thesis was to find out how mathematics related self-efficacy and task-motivation develop from 1st to 2nd grade, and are there any differences between gender, parent's education level groups or mathematical fluency level groups. Furthermore, it was studied how mathematics related self-efficacy and task-motivation are associated with mathematical fluency in 1st grade spring and 2nd grade spring.

The data was collected in the University of Jyväskylä, in the Flare-study (2016-2018). The data was analyzed in repeated measures ANOVA and hierarchical regression analysis. The results showed that mathematics related self-efficacy increased among all groups, whereas task-motivation remain static. However, there were differences in mathematics related self-efficacy of boys and girls and between different fluency levels groups in task-motivation and self-efficacy as early as in 1st grade. Results also showed that gender, self-efficacy, and task-motivation explain together over 30% of the mathematical performance on the 1st grade. However, motivation and self-efficacy have different effects to mathematical fluency with boys and girls.

The general high level of self-efficacy and task-motivation, as well as the growing trend of self-efficacy, are important things to consider when teaching in the 1st and 2nd grade, when the impact of these two factors to academic achievements is known to be high and gender differences are found.

Keywords: Mathematical Performance, Mathematical Fluency, Self-Efficacy, Task-Motivation, Primary Education

CONTENT

SUMMARY

1 INTRODUCTION

In Finland, students perform in the world's leading head in mathematics, but their enjoyment of mathematics, and school in general, are particularly weak (Kupari et al., 2013; Välijärvi, 2015). There is evidence that self-efficacy and task-motivation in mathematics play a crucial role in regulating mathematical performance (Aunola, Leskinen & Nurmi., 2006; Kupari & Nissinen, 2015; Viljaranta, Nurmi, Aunola & Salmela-Aro, 2009). It is also indicated, that these beliefs of value and perceptions of ability develop early and are difficult to change later in academic path (Gottfried, Marcoulides, Gottfried, Oliver & Guerin, 2007). Even if negative values would not influence on performance, they effect in how students avoid mathematics in future choices (Tuohilampi, 2016; Gottfried et al., 2007; Hackett, 1985). Therefore, it is important to study how these affects, beliefs and values develop.

According to Tuohilampi (2016), in general children tend to have positive attitude towards school and school work in the first grades. During the school years this situation changes, and children are less positive about their skills. Especially in mathematics, a decrease in effort and persistence can be seen (Tuohilampi, 2016; Pajares & Graham, 1999). Aunola et al. (2006) point out that mathematics is perceived to be more difficult, demanding more effort than many other school subjects and requiring more motivational constructs than other school subjects. Previous studies show that children's mathematical performance seems to be sensitive to various influences, such as motivational, cognitive, and affective influences (Wigfield & Meece, 1988).

The research on self-efficacy and motivation has focused largely on high-school students and university students (see for example Zimmerman, Bandura, & Martinez-Pons, 1992; Pajares & Kranzler, 1995; Amrai et al., 2011), but the study of younger children is rather rare (Aunola et al., 2006). Furthermore, research on mathematical related task-motivation's and self-efficacy's effects on mathematical performance or especially on mathematical fluency is scarce.

This study puts on effort to partially fill in these gaps in research of young children from 1st grade spring to 2nd grade spring and has three main purposes. First purpose is to find how self-efficacy develops and is there differences between groups. Second purpose is to research how mathematics related task-motivation develop and is there difference between groups. Third purpose is to find how mathematics related self-efficacy and task-motivation are associated with mathematical fluency in 1st grade spring and 2nd grade spring. Main concepts of this study are self-efficacy, task motivation and learning mathematics (Figure 1).

The overall structure of this study takes the form of four chapters. First, a brief overview of the main concepts is given and the field of study around these subjects is described. Chapter two consist of methods and data-analysis and chapter three describes the results of this study. Finally, in chapter four the results are discussed in the light of previous studies, particularly focusing in importance of enhancing math-related self-efficacy and task-motivation in early-education.

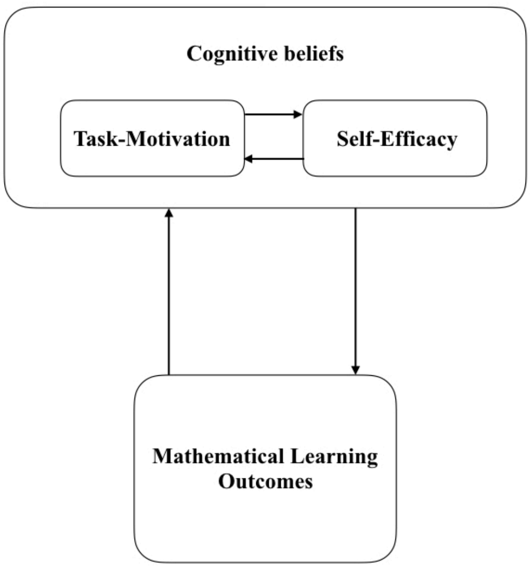

Figure 1. Relations of main concepts of this study

1.1 Learning mathematics

Learning mathematics constitutes of various concepts. According to Dowker (1998), arithmetic ability, or mathematical performance, is not unitary. It has several components, such as memory for arithmetical facts, ability to follow procedures, the understanding of mathematical concepts, and basic number knowledge (Dowker, 1998). Dowker (1998) further suggests that it is relatively easy to find discrepancies with these components among children. It can be then concluded that children do not have same development paths or same emphasize on these components.

According to Bryant and Nunes (2002) there are three bases to children's early mathematical knowledge and its development: logic and logical development (for example additive and multiplicative reasoning depend on the use of logic, and use of logic is not innate), teaching of conventional systems (as counting systems are based partly on logic an partly on human invention, children should be taught how to use counting systems) and meaning (evidence suggest that children learns most with situations and actions that mean something to them). Aunola, Leskinen, Lerkkanen & Nurmi (2004) note that child's development of mathematics may proceed in two ways: child's knowledge and skills gradually accumulate over time (child with good skills increase performance more than a child with poorer skills), or individual differences decrease rather than increase over time (child with poorer skills catch up with those who had higher skills at start).

Behind learning mathematic skills, there are found to be factors effecting to learning. Parent's high education has been found out to have a positive effect on mathematical performance from the analysis of PISA and TIMSS -studies (Brese & Mirazchiyski, 2010) and in the research of Penner and Parret (2008). Meta - analysis of contemporary studies indicate that there is no gender difference in mathematics performance (Linberg, Hyde, Petersen, & Linn, 2010).

One way to assess children's performance in mathematics is to use mathematical fluency. Mathematical fluency is essential to student's mathematical development, as being secure with important mathematical procedures let students undertake more complicated tasks (Foster, 2018; Hinton, Strozier & Flores, 2014). Fluency, or procedural fluency, is defined as the ability to apply procedures efficiently, accurately and flexibly, to transfer procedures to another contexts and problems, to modify or build procedures from other procedures, and to recognize when one procedure or strategy is more appropriate than the other for the given situation (National Council of Teachers of Mathematics, 2014).

There is evidence that mathematical performance level and emotions towards mathematics are linked among adolescents (Holm, Hannula & Björn, 2017) and that children with low mathematical performance feel more mathematics related anxiety than typically performing children (Wu et al., 2014). When defining children with lower and typical mathematical performance, Mazzocco (2008) suggests a cut off score of under 11th percentiles for mathematical learning disabilities, 25th percentiles for low performing children and over 25th percentiles for typically performing children. Separation of 11th and 25th percentiles is also recommended to avoid diluting any effects, because these groups seem to differ significantly with each other (Geary 2011; Geary et al., 2008; Mazzocco, 2008).

However, because performance or mathematical difficulties are not in the center of this study, under 25th percentiles cut-off score was chosen for low achieving children. In addition, there was interest to study if there were differences between low and typically performing children to high performing children. Similarly, 25% group (over 75th percentiles) was used to separate higher performing children for this study.

1.2 Learning and motivation

Motivation can be defined various ways, for example addressing the purposes or reasons to do actions, or having interest doing them (Wigfield & Cambria, 2010). Eccles, Wigfield and Schiefele (1998, 6) summarized the thought process of a different purposes that child either has or has not for engaging in different activities in the form of a hypothetical question: “Do I want to do this activity and why?”.

In educational settings, motivation has been conceptualized different ways (see eg. Viljaranta, 2010). According to Cook and Artino (2016), there are five contemporary motivation theories. These five theories have some recurring themes: competence beliefs, social-cognitive, value and attribution (Cook & Artino, 2016). Weiner (1985) views the motivation from the perspective of causal attribution, where the main concern is one's subconscious causal explanations (attributions for the results), and from the point of self-determinate behaviors, which include intrinsic and extrinsic motivation (see e.g. Deci and Ryan, 1985; 2000). In addition, motivation has also been conceptualized from the point of goal orientation, where different sets of goal orientations concern the purposes of achievement behavior (Ames, 1992; Meece, Blumenfeld & Hoyle, 1988). There is also the theory of expectancy values, where the focus is on subjective task values, such as usefulness and cost influences achievement behavior (Eccles et al., 1983). Finally, the self-efficacy perspective concerns on the individual's belief that given academic tasks can successfully be accomplished at designated levels (Schunk, 1991).

One contemporary way to view school motivation is the concept of student engagement. It refers to the student's connection or involvement with the endeavor of schooling and all the factors that composes it: people, activities, goals, values, and place (Skinner, Kindermann, & Furrer, 2008). Student engagement has three dimensions: affective engagement (student's attachment to school and members of the school community), behavioral engagement (student's participation in school activities, both academic and non-academic) and cognitive engagement (literature on educational values and achievement motivation) (Virtanen, 2016). According to Saeed and Zyngier (2012), student engagement considers the contextual variables, such as personal and familiar circumstances, and analyze how these variables affect to one´s engagement in learning. Intrinsic motivation and extrinsic motivation are both associated with student engagement, and to effectively build motivation and engagement, teachers needs to use them both (Saeed & Zyngier, 2012).

1.3 Task motivation

One specific way to assess children motivation's in mathematics is to use the concept of task-motivation, which assesses the interest students show in school subjects. It is a widely used framework in this area of study. Aunola et al., (2006) used the term task motivation to refer children's interest value or intrinsic motivation towards school subjects. In this study, we use the term task-motivation to describe student's interest and (intrinsic) motivation towards mathematics. There is evidence that children do have high self-perceptions of competence and intrinsic motivation in the first grades, but these optimistic self-perceptions decline trough the following years (Bouffard, Marcoux, Vezeau, & Bordeleau 2003; Eccles et al., 1993; Jacobs et al., 2002).

It has been shown that there is a relationship between components of motivation and academic achievement (Amrai et al., 2011; Zimmerman, Bandura, & Martinez-Pons, 1992) and math performance (Stevens et al., 2004), but the direction of this association has been inconsistent: there is effect, or there is not any effect, or the effect is reciprocal (see e.g. Garon-Carrier et al., 2016). While in some studies task motivation predicted mathematical performance (Aunola et al., 2006), there are also studies where this relationship was not found (Bouffard, Marcoux, Vezeau & Bordelau, 2003; Marsh, Trautwein, Ludtke, Koller, & Baumert, 2005). In addition, a reciprocal relationship has been found: one's higher performance leads to higher motivation, which leads again to a higher interest on the task on hand, and hence to a higher performance level (Aunola et al., 2006; Gottfried, 2007). In contrast, higher mathematical achievement has been found out to led to higher intrinsic motivation (Garon & Carrier, 2017).

Research has also showed some gender differences: whereas boys value mathematics more than girls, girls value reading more than boys (Nurmi & Aunola, 2005; Eccles, 1993; Eccles, Wigfield, Harold & Blumenfield, 1993). In addition to mathematics, boys have been found out to also value sciences more than girls. (Eccles, Barber & Josefowicz, 1999; Ganley & Lubienski, 2016).

1.4 Self-efficacy

Self-efficacy is defined as people's beliefs about their capabilities to produce effects and given attainments (Bandura 1994, 1997; 2006). Expectations of self-efficacy determine how much effort one will utilize and how long it will be sustained when facing challenges (Bandura, 1977). Beliefs of self-efficacy also determine how people behave, motivate themselves, think and feel (Bandura, 1994). The development of self-efficacy beliefs has four sources: previous mastery experiences (one's successes and failures), vicarious experiences (seeing someone else succeeding or failing), support and feedback from the environment (encouragement or discouragement from other people) and one's emotional and physical reactions and their perceptions and interpretations of them (e.g. physical stress reactions) (Bandura, 1994; Aro, 2014).

Students' self-efficacy in mathematics have been found to be a suitable measure for predicting future performances in mathematics (Lee, 2009; Pajares & Miller, 1997; Pajares & Graham, 1999). Research of self-efficacy has been conducted to both elementary school and higher education. In the grades 1 and 2 child is still at the Piaget's concrete operational stage, where children can understand more complex abstract concepts and apply them, but still have trouble thinking them out-of-context (Piaget, 1964). The cognitive processes are seen mainly to affect to emotions in this stage and can be seen from the research of self-efficacy as well: for example, children with a higher self-efficacy have a higher mathematical performance (see e.g. Wigfield & Eccles, 2002). Later, in higher education, children are at the Piaget's formal operational stage, and are able to do more abstract, hypothetical and theoretical reasoning and engage "if-then" reasoning (Piaget, 1964). Now, children can think themselves to different situations, hence self-efficacy also have a broader effect: for example, self-efficacy affects academic attainment (Zimmerman, Bandura, & Martinez-Pons, 1992) or to the selection of college major (Hackett, 1985).

On the context of elementary school research on mathematics-related self-efficacy is scarce, but Tuohilampi (2016) found out that the decrease of self-efficacy was more dramatic among girls and Joët et al. (2011) found out that girls had lower mathematics related self-efficacy in 3rd grade. In previous research, gender differences on mathematics self-efficacy has been found: boys had higher self-efficacy than girls (Pajares & Miller, 1994; Louis & Mistele, 2012; Huang 2012, Joët & Usher, 2011).

In addition, self-efficacy has been found out to have a strong relationship with mathematic performance (Ayotola & Adedeji, 2009; Hackett, 1985; Pajares, 1996). Self-efficacy has been also found out to mediate the effect of gender, prior experience on math self-concept and math problem-solving performance in the context of elementary school (Pajares & Miller, 1994; Pajares & Miller, 1997).

In the context of higher education, self-efficacy has found out to predict mathematics performance more than math anxiety (Pajares & Miller, 1994) or previous math experience (Hackett, 1985; Pajares & Miller, 1995; Pajares & Kranzler, 1995). Stevens et al. (2004) found out that students in high school with high level of self-efficacy will continue to work on a task despite its challenges. According to Zimmerman, Bandura, and Martinez-Pons (1992), in University context, perceived efficacy to achieve seems to motivate academic attainment both indirectly and directly by influencing one's personal goal settings.

According to Schunk and Pajares (2002), parents and custodians do influence children's self-efficacy, if there's a positive environment that stimulates curiosity and allows mastery experiences. This relationship goes also the other way: children can also promote parental responsiveness by being curious and exploratory (Schunk & Pajares 2002).

1.5 Research questions

The aim of this study is to investigate mathematics related self-efficacy and task-motivation in longitudinal data from 1st grade spring to 2nd grade spring. Although a few studies have investigated self-efficacy and task-motivation in early education (e.g. Joët et al., 2011; Aunola et al., 2006), the development of these are not followed or compared between mathematical performance groups or parent education levels. Also, it is interesting to study, what is the relationship of math-related self-efficacy and task-motivation to mathematical skills in early grades.

Independent variables used in this study are mathematics related self-efficacy, -task-motivation and mathematical fluency measured in 1st grade spring and in 2nd grade spring.

The specific research questions of this study were the following:

1 How does mathematics-related self-efficacy develop during the 1st and 2nd grades?
   - 1.1 Are there differences in the development and levels of self-efficacy between genders?
   - 1.2 Are there differences in the development and levels of self-efficacy between parent's education groups?
   - 1.3 Are there differences in the development and levels of self-efficacy between mathematical fluency levels?

2 How does mathematics related task-motivation develop during the 1st and 2nd grades?
   - 2.1 Are there differences in the development and levels of task-motivation between genders?
   - 2.2 Are there differences in the development and levels of self-efficacy between parent's education groups?
   - 2.3 Are there differences in the development and levels of self-efficacy between mathematical fluency levels?

3 How mathematics related self-efficacy and task-motivation are associated with mathematical fluency in 1st grade spring and 2nd grade spring?

2 METHOD

2.1 Data collection and participants

This study is a part of the FLARE-study in the University of Jyväskylä, which started in spring 2016. FLARE is funded by the Academy of Finland (277340; 9/2014-8/2018). Focus of the research project is on the development of children's' reading and mathematics skills. Children's' cognitive skills, motivation and self-beliefs are also monitored. The main objective of the FLARE-study is to have more information about what factors affect to the comorbidity of reading and mathematics skills. Children were examined five times; in 1st grade spring 2016, 2nd grade fall 2016, 2nd grade spring 2017, 3rd grade fall 2017 and 3rd grade spring 2018.

Participation in the FLARE-study has been optional for the schools, classes and students involved. The custodians of the children involved in this study has given a written consent in order to participate. Interruption of the study has been possible, and information about interrupting has been given to both children and custodians. The main purpose of the study has been also told to the custodians, as well as their right to know about the study results of their children. The results could be given to the teacher, if the custodians of the children have given permission to this. A single participant cannot be separated from the research data, and the workers involved in the research have given a nondisclosure agreement. Data collectors were workers and research assistants working for the research. FLARE-study has been implemented according to the research ethic principles and a written consent from the Ethical Committee of the University of Jyväskylä was asked before starting the research.

2.2 Measurements

The original longitudinal data from the FLARE-study in the University of Jyväskylä, was collected first time in 2016. The original data consisted of 207 children (97 boys, 103 girls, 7 unknown) in 2016. For this study, two measurement points were used: 1st grade spring 2016 and 2nd grade spring 2017.

In this study, mathematical fluency was used to measure the mathematical performance. It was assessed with two tests: The Addition Fluency Test (Koponen & Mononen, 2010a) and The Subtraction Fluency Test (Koponen & Mononen, 2010b). These tests consist of addition and subtraction tasks on paper and have a time limit of two minutes. Final score was the number of the correct answers. Parallel versions of this test were used in different measurement points. The sum score of addition and subtraction fluency was used as a mathematical performance variable.

Children's mathematical self-efficacy and task-motivation was assessed by questionnaires. Self-efficacy was assessed by assisted questionnaire conducted by research assistants and task-motivation was assessed by assistant-assisted computer questionnaire. Self-efficacy questionnaire consisted of 11 items asking children opinion of "how sure you are that you can…" in 5 point Likert-scale (1= completely sure that I can't, 5= completely sure that I can). These questions asked children beliefs in current capability in mathematics, capability to learn mathematics and capability to use mathematical skills generally in life. Task-motivation in mathematics questionnaire involved three items asking children preference to do mathematical tasks in school and in home. Scale was 5-point Likert-scale (1=tasks are boring/ I don't like to do those tasks, 5=tasks are nice/ I like to do those tasks). For this study, a sum score of the items in questionnaire was calculated (Cronbach's alpha for task-motivation was .89–.91 and for self-efficacy .80–.82).

Background information was gathered from children's parents. They filled a questionnaire asking, "respondent's highest education" and "the other parents highest education". For the parent's education grouping variable, parents (or respondent's) highest education was selected, and two groups of education level were made (Table 1).

Mathematical fluency levels (low, typically and high performing children) were assessed from the percentiles of mathematical fluency skills in 1st grade spring (range 1.25 –19.50). A total of 44 students (23 boys, 21 girls) met the criteria for low mathematical fluency (LMP) by scoring under 25th percentiles (score range from 1.25– 5.50) whereas 93 children (40 boys, 53 girls) (percentiles from 25th–75th, range 5.75–10.00) were assigned to typically performing group (TMF). A total of 47 children (26 boys, 21 girls) performed over 75 percentiles (range 10.25–19.50) and were assigned to high fluency group (HMP). In the levels, genders were statistically equally distributed χ^2 (2, N = 181) = 2.25, p=.363.

Table 1. Parents education levels

	Lower Education N	Higher Education N
1= Lower Secondary Education	3	
2= Upper Secondary Education Vocational School	62	
3= Upper Secondary Education High-School	19	
4= Post-Secondary (non-tertiary) Education	21	
5= Bachelor or equivalent level		41
6= Master or equivalent level		33
7= Doctoral or equivalent level		5
Total N=184	105	79

2.3 Data analysis

Analysis of this study was performed in SPSS 24. After scanning required variables for missing data, 22 children were excluded from the analysis. Then univariate outliers were detected, and one outlier was deleted in the recommendation presented by Tabachnick and Fidell (2014), because standardized score in mathematical performance in 1st grade spring was excess of 3.29. These actions leaved final data to 184 children (89 boys, 95 girls). Normality of the dataset was analyzed and found in general adequate; in the range on −1–+1 for the skewness divided by its standard error and quite well in the range of −2–+2 in kurtosis when the score was dived by its standard error (Brown, 2011). Assumption of normality was not met for all variables, when data was checked by grouping variables. Then the statistical results were checked via non-parametric analysis methods and they showed similar results between groups indicating that the violations of normality were not extreme. For the used variables in multivariate methods correlation coefficients (Appendix 3 & 4) were checked and found acceptable in terms of multicollinearity (Tabachnick & Fidell, 2014).

The results for the first research question were obtained via repeated measures ANOVA. Both in the development of self-efficacy and task-motivation, there were three between subject factors: gender, parent's education level-groups and mathematical fluency level-groups in 1st grade spring. Covariance's, sphericities and multicollinearities (Pearson correlations of variables in Appendix 2) of variables were checked, and though Box's M was significant in repeated measures ANOVA of self-efficacy ($p=.003$). However, the analysis was regarded as robust enough because of relatively large sample size (Tabachnick & Fidell, 2014).

The results for the third research question were obtained via hierarchical regression analysis. This analysis was performed in two different models, to find out differences between measurement points (Table 2). Residuals of regression analyses were checked for normality, linearity and homoscedasticity and found as acceptable (Tabachnick & Fidell, 2014).

In addition, statistical power and effect sizes were analyzed by GPower-program using 95% confidence in order to monitor risks for decision errors in statistical inferences (e.g. Mayr et al., 2007; Wilson vanVoorhis & Morgan, 2007). Evaluating effect sizes Cohen d is used for in t-test's, Cohen q for correlations, *partial eta*^{2} for repeated measures ANOVA and Cohen f^2 for hierarchical regression analysis (Cohen, 1998). Effect size of an independent factor in hierarchical regression analysis is evaluated from partial R^2 (Aberson, 2015; Faul, Erdfelder, Buchner & Lang, 2009).

Table 2. Explanations of three hierarchical regression models used in data-analysis

Hierarchical Regression Models		
	Depend Variable	Independent Variables
MODEL 1	Mathematical Fluency 1st Grade Spring	Gender Parent's highest education Task-Motivation 1st Grade Spring Self-Efficacy 1st Grade Spring
MODEL 2	Mathematical Fluency 2nd Grade Spring	Gender Parent's highest education Task-Motivation 2nd grade Spring Self-Efficacy 2nd grade Spring Mathematical Fluency 1st Grade Spring

3 RESULTS

3.1 Development of mathematics related self-efficacy

First set of analyses examined the development of mathematics related self-efficacy with three between subject's factors: gender, parent education level-group and mathematical fluency level-groups. Repeated measures ANOVA showed statistically significant main effect and large effect size for time, indicating that self-efficacy develops from 1st grad to 2nd grade (Figure 2; Table 3). There were no statistically significant interactions between time and independent variables (Table 3).

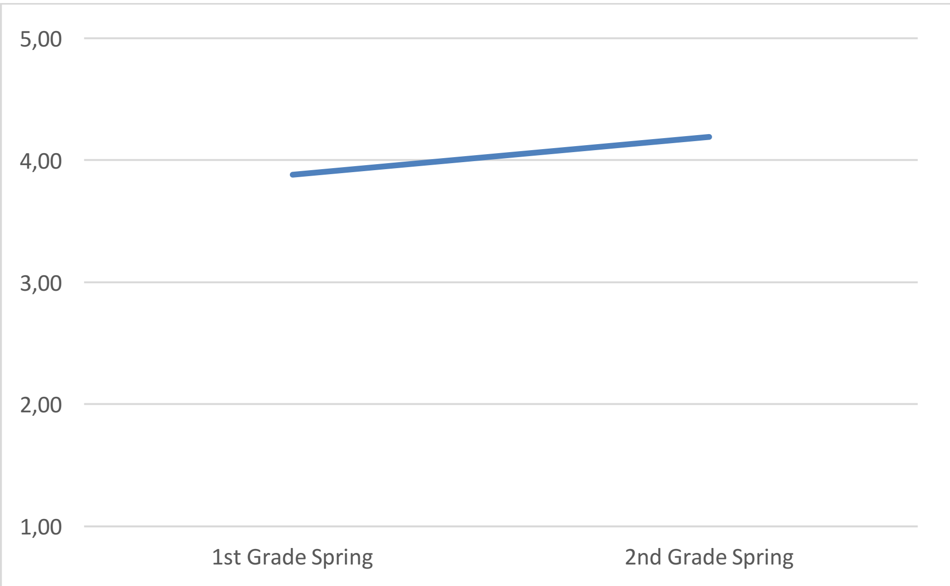

Figure 2. Development of Self-Efficacy (1st grade spring M=3.88, SD=0.72; 2nd grade spring M=4.19, SD=0.61)

Table 3. Summary of Repeated Measures ANOVA Within-Subjects Effects of Self-Efficacy

Source	Sum of Squares	df	Mean Square	F	η_p^2
Time	6.84	1	6.844	36.99***	.18
Time x Gender	0.61	1	0.61	3.28	.02
Time x PEL	0.01	1	0.01	0.08	.00
Time x MPL	0.16	2	0.08	0.42	.01
Time x Gender x PEL	0.13	1	0.13	0.70	.00
Time x Gender x MFL	0.01	2	0.00	0.02	.00
Time x PEL x MFL	0.08	2	0.04	0.23	.00
Time x Gender x PEL x MFL	0.02	2	0.01	0.05	.00
Error	31.83	172	0.19		

Note. ***$p < .001$

PEL=Parent's Education Level, MFL=Mathematical Fluency Level.

In addition, self-efficacy and mathematical fluency levels had statistically significant between subject's main effect $F(2,172) = 27.84$, $p<.001$) and large effect size $\eta_p^2 = .25$). Means (Appendix 1) and pairwise comparison (Bonferroni) stated that children with high mathematical fluency performance had statistically better self-efficacy than children with typical mathematical fluency performance ($p<.001$) and low mathematical fluency performance ($p<.001$), and there was also same difference between children with typical mathematical fluency performance and children with low mathematical fluency performance ($p<.001$) (Figure 3).

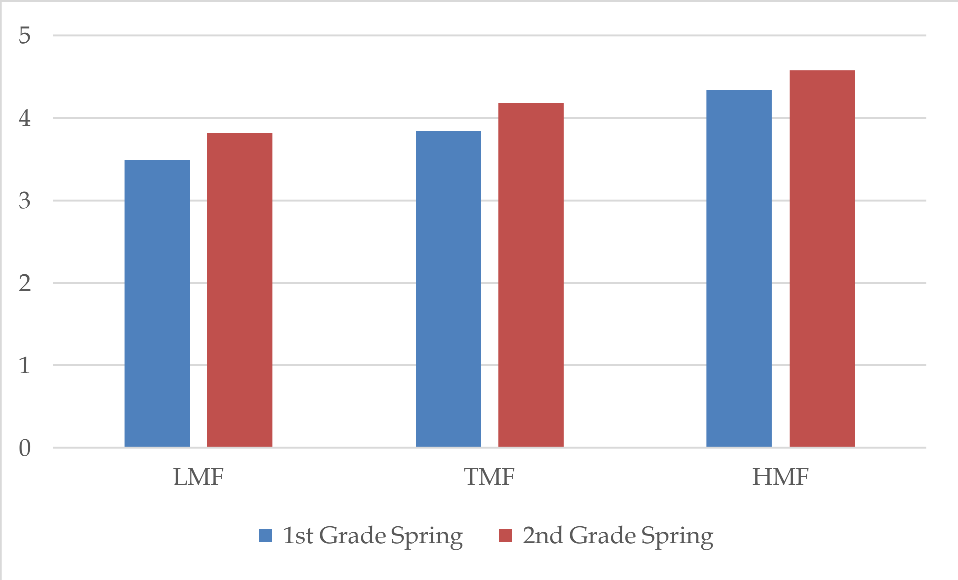

Figure 3. Differences in Means (Appendix 1) of Self-Efficacy Between Low (LMF), Typical (TMF) and High (HMF) Mathematical Fluency Levels in 1st grade spring and in 2nd grade spring

Similarly, gender had significant between subject main effect F (1,172) = 12.77, p <.001 and medium effect size $\eta_p^2 = .07$. Means (Appendix 1) and pair-wise comparison (Bonferroni) showed that boys had significantly better self-efficacy (p<.001) (Figure 4).

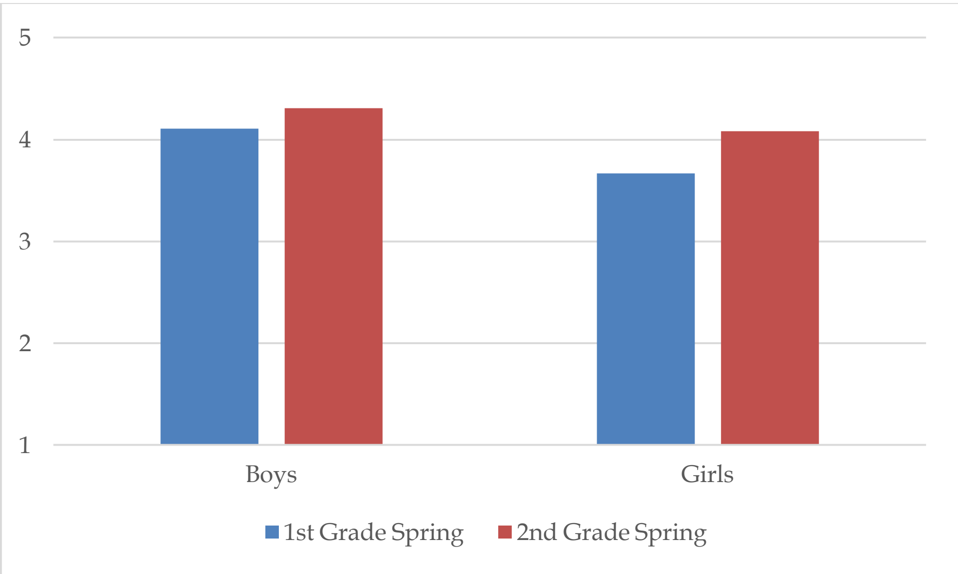

Figure 4. Difference in Means (Appendix 1) of Self-Efficacy of Boys and Girls

Finally gender x parent's education group had statistically significant between subject's main effect F (1,172) = 6.49, p=.036) and small effect size $\eta_p^2 = .04$. Means (Appendix 1) and pair-wise comparisons (Bonferroni) showed that girls with low-educated parents had statistically significant lower self-efficacy than girls with higher educated parents (p=.004) and boys with low and high educated parents (p<.001). There was no statistically difference between girls with high educated parent's and boys with low or high educated parent's (Figure 5).

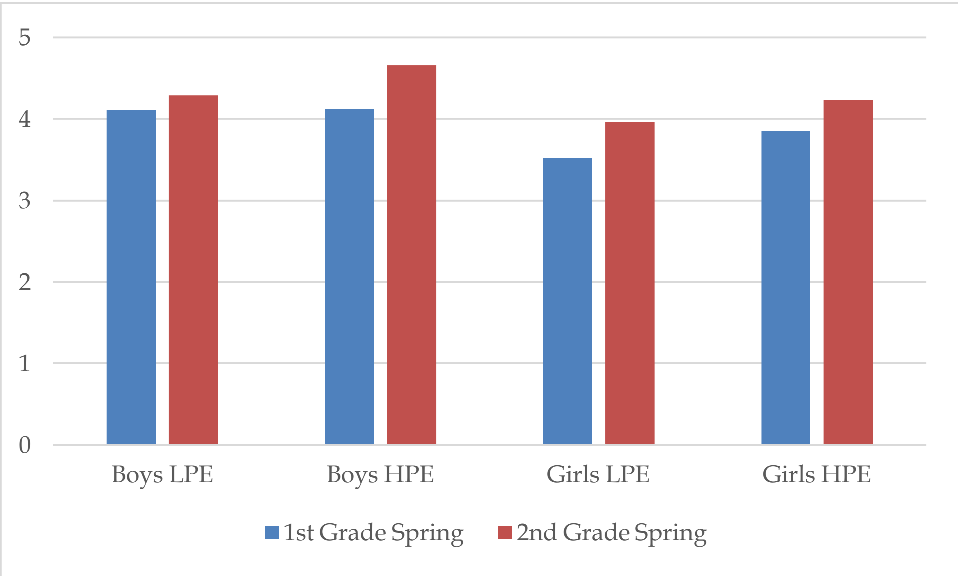

Figure 5: Difference in Means (Appendix 1) of Self-Efficacy between Gender x Parents education level. LPE= Low Parents Education, HPE=High Parents Education

3.2 Development of mathematics related task-motivation

Second set of analyses examined the development of mathematics related task-motivation with three between subject's factors: gender, parent education level-group and mathematical fluency-level groups. Repeated measures ANOVA showed no statistically significant main effect for time, indicating that task-motivation did not develop from 1st grad to 2nd grade (Table 4). There were no statistically significant interactions between time and independent variables (Table 4).

Table 4. Summary of Repeated Measures ANOVA Within-Subjects Effects of Task-Motivation

Source	Sum of Squares	df	Mean Square	F	η_p^2
Time	0.13	1	0.13	0.18	.00
Time x Gender	1.45	1	1.45	2.07	.01
Time x PEL	0.07	1	0.07	0.10	.00
Time x MFL	3.17	2	1.59	2.27	.03
Time x Gender x PEL	0.50	1	0.50	0.71	.00
Time x Gender x MFL	0.30	2	0.15	0.21	.00
Time x PEL x MFL	1.66	2	0.82.	1.19.	.01
Time x Gender x PEL x MFL	4.150	2	2.07	2.97	.05
Error	120.213	172	.70		

Note: PEL=Parent's Education Level, MFL=Mathematical Fluency Level.

However, task-motivation and mathematical fluency levels had statistically significant between subject's main effect F (2,172) = 17.22, $p<.001$) and large effect size ($\eta_p^2 = .17$). Means (Appendix 2) and pairwise comparison (Bonferroni) stated that children with high mathematical fluency level had statistically better task-motivation than children with typical mathematical fluency level ($p<.001$) and low mathematical fluency level ($p<.001$), and there was also the same difference between typical mathematical fluency level children and low mathematical fluency-level children ($p<.001$) (Figure 5).

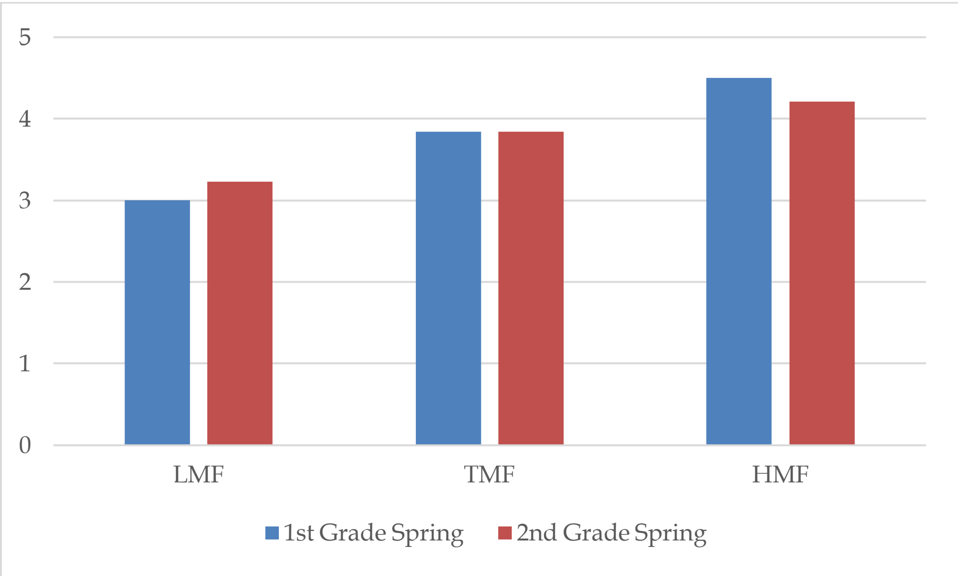

Figure 6. Means (Appendix 2) of Task-Motivation Between Low (LMF)-, Typical (TMF)- and High (HMF) Mathematical Fluency Levels in 1st grade spring and in 2nd grade spring

3.3 Mathematics related self-efficacy's and task-motivation's associations with mathematical fluency

The third research question was to study how mathematics related self-efficacy and task-motivation effects on mathematical fluency. It was analyzed by hierarchical regression analysis. Independent variables were gender and parents' education, and earlier mathematical fluency (if available). The correlation coefficients and means are displayed in Appendix 3. First interest was to study mathematical fluency in 1st grade spring and how much 1st grades mathematics related task-motivation and self-efficacy explains it.

Table 5 displays the standardized coefficients β and the ΔR^2 for models. In the first step of the model, gender [F_{inc} (1,182) = 0.10, p = .756] and second step gender and parent's education [F_{inc} (1,181) = 1,294, p = .257] were not statistically significant predictors in explaining mathematical fluency in 1st grade spring. Models explanation ascended to 18% and was statistically significant [F_{inc} (1,180) = 41.53, p< .001] with medium effect size (Cohen f^2 = .24), when self-efficacy was added in the third step. Standardized coefficients β and medium effect size of self-efficacy (Cohen f^2 = .23) shows that only self-efficacy had statistically significant positive independent effect.

When task-motivation was added in the fourth step, model's explanation increased to 28% [F_{inc} (1,179) = 27.14, p<.001]. Standardized coefficients β showed that gender, self-efficacy, and task-motivation had their own independent statistically significant positive effect on mathematical fluency on 1st grade. Further examinations of effect sizes of independent factors in fourth step suggest that self-efficacy (Cohen f^2 = .13) and task-motivation (Cohen f^2=.11) had similar small effects and gender effect size (Cohen f^2= .02) had small effect size.

After step 4, with all the independent variables in the equation, R^2 = .30 with 95% confidence limits from .19 to .38 [F (1,179) = 19.16, p<.001]. Adjusted R^2 value of .28 indicates that over a quarter of mathematical fluency was predicted by IV's with large effect size (Cohen f^2 = .43).

Table 5. Results of hierarchical regression analysis of children gender, parent's education level, children self-efficacy and task-motivation in mathematical fluency at 1st grade spring

MODEL 1				
	Step 1	Step 2	Step 3	Step 4
	β	β	β	β
Gender	-.02	-.02	.12	.13*
Parent's Education Level (Lower/Higher)		.08	.03	.03
Self-Efficacy (1st grade spring)			.46***	.38***
Task-Motivation (1st grade spring)				.34***
	ΔR^2=.00	ΔR^2=.01	ΔR^2=.19***	ΔR^2=.11***

*Note. * p< .05, *** p< .001. Gender: 0=boy, 1=girl. Parent's Education Level: 0=lower, 1=higher.*

At the second part of this analysis, 2nd grade mathematical fluency was examined through 2nd grades mathematics related task-motivation and self-efficacy. Other independent factors in Model 2 were gender, parent's education level, and at the fifth step: 1st grade mathematical fluency. 1st grades mathematical fluency was added to examine how well self-efficacy and task-motivation hold their -value, if strongly explaining independent variable is included in the model.

Table 6 displays the standardized coefficients β and the ΔR^2 for Model 2. At the first step of analysis gender was statistically significant predictor of mathematical fluency [F_{inc} (1,182) = 6.00, p = .015] with adjusted R^2 of 3%, and small effect size (Cohen f^2=.03)[1].

[1] Mean scores of mathematical fluencies in 2nd grade [boys (M = 13.35, SD = 6.49), girls (M = 11.36, SD = 4.37)] Independent samples t-test showed moderate significance difference t (152.8) = 2.42, p = .017 and small effect size of Cohen d = .359) for boys to have better mathematical fluency.

Table 6. Results of hierarchical regression analysis of effects on gender, parents' education, 2nd grade math related task-motivation, self-efficacy and mathematical fluency in 1st grade on mathematical fluency in 2nd grade spring

MODEL 2					
	Step 1	Step 2	Step 3	Step 4	Step 5
	β	β	β	β	β
Gender	-.18*	-.18*	-.09	-.09	-.15**
Parent's Education Level (Lower/Higher)		.10	.04	.05	.04
Self-Efficacy (2nd grade spring)			.46***	.38***	.06
Task-Motivation (2nd grade spring)				.20***	.12*
Mathematical Fluency (1st grade spring)					.69***
	ΔR^2=.03*	ΔR^2=.01	ΔR^2=.20***	ΔR^2=.04**	ΔR^2=.36***

*Note. * p< .05, **p< .01 *** p< .001. Gender: 0=boy, 1=girl. Parent's Education Level: 0=lower, 1=higher.*

In the second step of the Model 2, gender and parent's education level together were not able to explain mathematical fluency in 2nd grade [F_{inc} (1,181) = 1.90, p = .174] statistically significantly. In the third step, when mathematics related self-efficacy in the 2nd grade was added, model's explanation increased to 23% [F_{inc} (1,180) = 46.86, p < .001] with a medium effect size (Cohen f^2=.32). Standardized coefficients β and medium effect size of self-efficacy (Cohen f^2=.32) showed that it was the only independent variable to have statistically significant effect at this step.

When mathematics related task-motivation in 2nd grade was added in step 4, the overall explanation of model increased 3%; *F* (1,179) =8.76, p< .001. Standardized coefficients β values suggest that statistically significant independent variables in this step were self-efficacy and task-motivation. Further examinations of effect sizes of independent factors in fourth step suggest, that self-efficacy (Cohen $f^2 = .14$) and task-motivation (Cohen $f^2=.04$) had small effects, but self-efficacy is clearly stronger predictor at 2nd grade.

After step 4, with all the same independent variables as in the Model 1 in the equation, $R^2 = .28$ with 95% confidence limits from .17 to .35 [F (1,179) = 16.98, $p < .001$] and with a large effect size (Cohen $f^2= .35$). Adjusted R^2 value of .26 indicates, that in 2nd grade, the same IV's predicts slightly less of mathematical fluency than in 1st grade.

Finally, adding 1st grades mathematical fluency to the Model 2, explanation of the model increased to 62%; F_{inc} (1,178) =171.40, $p< .001$, with large effect size of the model (Cohen $f^2=1.70$). In fifth step, gender, task-motivation and 1st grades mathematical fluency had significant independent effect to mathematical fluency of 2nd grade. Standardized coefficients β and effect sizes suggest that earlier mathematical fluency with large effect size (Cohen $f^2=.55$) is the strongest predictor of later mathematical fluency. Gender had small effect size (Cohen $f^2=.02$) and task-motivations had no effect size (Cohen $f^2=.01$). However, with earlier fluency in model, task-motivation had significant independent effect, while self-efficacy was not able to predict mathematical fluency at 2nd grade. Statistically significant negative effect of gender refers to boy's better probability to have higher mathematical fluency in second grade, when earlier fluency and task-motivation are in the model.

Gender differences in results of Models 1 and 2, led to analyze Pearson correlations of DV's and IV's separately for genders (Figure 7; Appendix 4). Results showed that correlations of girl's task-motivation and mathematical fluency in 2nd grade is lower than boy's equivalent, but the difference was not statistically significant ($p= .062$). In addition, correlation between girl's mathematics-related self-efficacy and task-motivation was non-significant in 1st grade and very low in 2nd grade, when boys equivalent correlated moderately. These differences between correlations of boys and girls were statistically significant ($p=.045$) with small effect size in 1st grade (Cohen's $q = 0.25$) and statistically significant ($p=.014$) with medium effect size in 2nd grade (Cohen's $q = 0.329$).

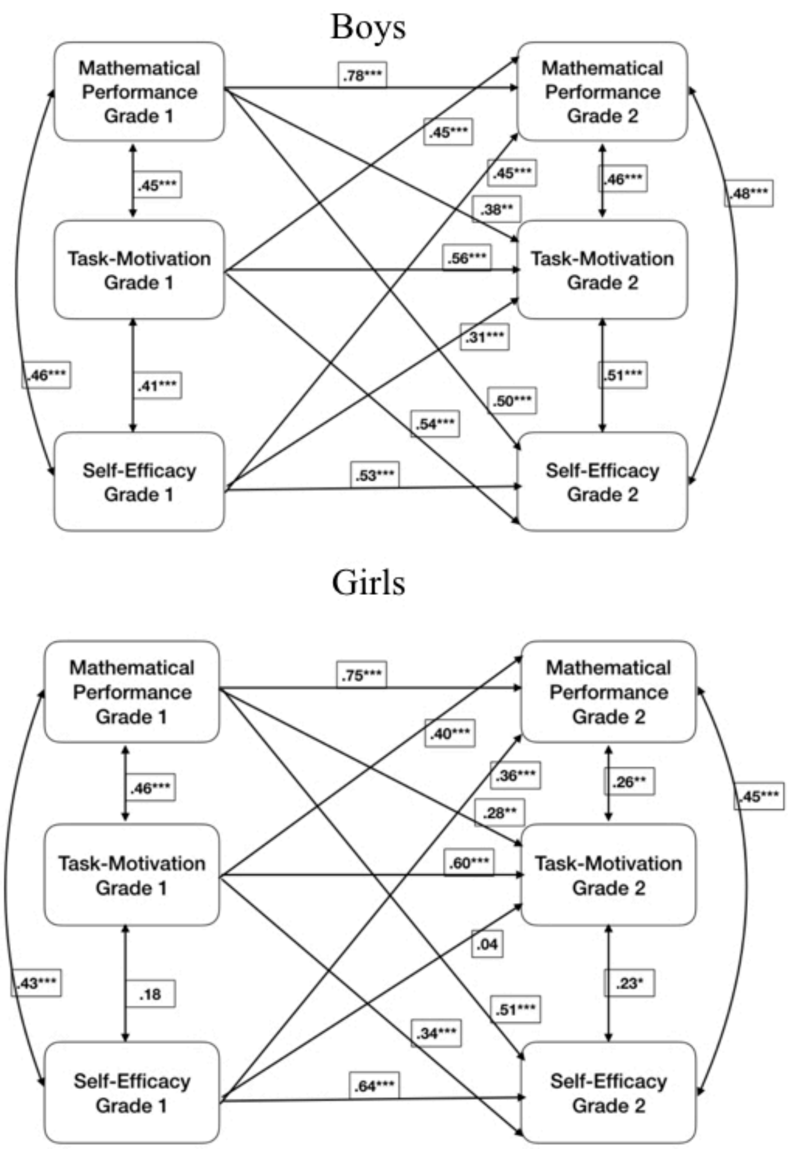

Figure 7. Pearson correlation coefficients separately for genders

In addition, hierarchical regression analyses for Model 1 and Model 2 were done separately to both genders (Table 7 and Table 8). Table 7 displays the standardized coefficients β and the ΔR^2 for Model 1 for both genders. In the first step of the model parent's education [$F_{inc\ boys}$ (1, 87) = 2.529, p = .115, $F_{inc\ girls}$ (1,93) = 0.24, p = .876] was not statistically significant predictor for boys or girls in explaining mathematical fluency in 1st grade spring. Mathematics related self-efficacy at the 2nd step added statistically significant [$F_{inc\ boys}$ (1,86) = 23.48, p < .001, $F_{inc\ girls}$ (1,92) = 23.92, p < .001] prediction to both gender with medium effect size of models (boys Cohen f^2 = .31, girls Cohen f^2 = .26). Adjusted R^2 values of Model 1 for boys was .22 and for girls .19. Standardized coefficients β's and similar medium effect sizes of self-efficacy (boys Cohen f^2=.26, girls Cohen f^2=.26) confirmed that self-efficacy was the only independent variable to have statistically significant effect at this step and predicted similarly for both genders. When task-motivation was added in third step, Model 1 had the same 30% of prediction for both genders [$F_{inc\ boys}$ (1,85) = 10.66, p < .01, $F_{inc\ girls}$ (1,91) = 15.41, p < .001], with large effect sizes (boys Cohen f^2 = .47, girls Cohen f^2 = .47). Standardized coefficients β and independent effect sizes of significant variables suggests that for boys, self-efficacy with small effect size (Cohen f^2 = .11) was better predictor in 1st grade than task-motivation with slightly smaller effect size (Cohen f^2 = .09) and for girls, self-efficacy with medium effect size (Cohen f^2 = .20) was better predictor in 1st grade than task-motivation with medium effect size (Cohen f^2 = .18).

Table 7. Results of hierarchical regression analysis of parent's education level, children self-efficacy and task-motivation effect in mathematical fluency at 1st grade spring: separately for both genders

MODEL 1			
	Step 1 β	Step 2 β	Step 3 β
BOYS Parent's Education Level (Lower/Higher)	.17	.16	.15
GIRLS Parent's Education Level (Lower/Higher)	-.02	-.12	-.12
BOYS Self-Efficacy (1st grade spring)		.46***	.34***
GIRLS Self-Efficacy (1st grade spring)		.47***	.42***
BOYS Task-Motivation (1st grade spring)			.32**
GIRLS Task-Motivation (1st grade spring)			.34***
BOYS ΔR^2=	.03	.21***	.09***
GIRLS ΔR^2=	.00	.21***	.12***

Note. ** *p*< .01, *** *p*< .001.

Table 8 displays the standardized coefficients β and the ΔR^2 both genders for Model 2. In the first step of the model parent's education [$F_{inc\ boys}$ (1, 87) = 1.384, p = .243, $F_{inc\ girls}$ (1,93) = 0.480, p = .490] was not statistically significant predictor for boys or girls in explaining mathematical fluency in 1st grade spring. Mathematics related self-efficacy at the 2nd step of model explains statistically significantly [$F_{inc\ boys}$ (1,86) = 28.28, p < .001, $F_{inc\ girls}$ (1,92) = 21.92, p < .001] mathematics fluency for both gender (boys adjusted R^2 = .24, girls adjusted R^2=.18). ΔR^2 and large effect sizes of boys (Cohen f^2 = .35) suggests that model predicted mathematical fluency better for boys than girls (medium effect size; Cohen f^2 = .24). Standardized coefficients β's showed that self-efficacy was statistically significant independent variable at this step for both genders, and independent effect sizes of self-efficacy were medium (boys Cohen f^2=.32, girls Cohen f^2=.23).

At the third step, adding task-motivation in model 2, boys model explains 29% of mathematical fluency [$F_{inc\ boys}$ (1,85) = 6.76, p < .05], with a large effect size (Cohen f^2 = .46). Standardized coefficients β and independent effect sizes of significant variables suggest that for boys, self-efficacy with small effect size (Cohen f^2 = .11) is better predictor also in 2nd grade, than task-motivation with small effect size (Cohen f^2 = .06). For girls, model at step 2 is not statistically significant ($F_{inc\ girls}$ (1,91) = 1,71, p = .194] and the result indicates that for girls, task-motivation did not contribute to prediction of mathematic fluency in 2nd grade.

However, when earlier mathematical fluency was added to model 2 in step 4, model explain 64% of mathematics fluency of boys [F_{inc} boys (1,84) = 83.81, p < .001] with a large effect size (Cohen f^2 = 1.92) and 56% for girls [F_{inc} girls (1,90) = 78,40, p < .001] with a large effect size (Cohen f^2 = 1.36). Standardized coefficients β's and variables independent effect sizes showed that earlier mathematical fluency was statistically significant independent variable at this step for both genders (large effect size; boys Cohen f^2=.52, girls Cohen f^2=.58). However, for boys, task-motivation had statistically significant positive effect with a small effect size (Cohen f^2 = .03). This result suggests, that earlier mathematical fluency added in model, task-motivation did have statistically significant contribution to model only for boys. In general, the Model 2 explained 8% more of variance for boys.

Table 8. Results of hierarchical regression analysis of effects on parent's education, 1st grades math related task-motivation and self-efficacy, and mathematical fluency in 1st grade, on mathematical fluency in 2nd grade spring: separately for both genders

MODEL 2				
	Step 1 β	Step 2 β	Step 3 β	Step 4 β
BOYS Parent's Education Level (Lower/Higher)	.13	.10	.14	.03
GIRLS Parent's Education Level (Lower/Higher)	.07	-.02	-.03	.07
BOYS Self-Efficacy (2nd grade spring)		.49***	.36***	.04
GIRLS Self-Efficacy (2nd grade spring)		.44***	.42***	.07
BOYS Task-Motivation (2nd grade spring)			.27*	.19*
GIRLS Task-Motivation (2nd grade spring)			.13	.04
BOYS Mathematical Fluency (1st grade spring)				.70***
GIRLS Mathematical Fluency (1st grade spring)				.71***
BOYS ΔR^2=	.02	.24***	.06*	.34***
GIRLS ΔR^2=	.01	.19***	.02	.37***

Note. * $p < .05$, *** $p < .001$.

4 DISCUSSION

The aims of this study were to find how mathematics related self-efficacy and task-motivation develops from 1st grade to 2nd grade and how those two associates with mathematical fluency. Results showed that the trend of mathematics related self-efficacy increased, whereas task-motivation remained static. There were no differences in development trends in different levels, however, there were evidence of differences between levels. Concerning self-efficacy, children had differences in between mathematical fluency level, so that the best-, average- and lowest performing children in fluency all differed from each other statistically significant and lowest performing child had the lowest self-efficacy. In mathematics related task-motivation, lowest performing children in fluency had lower task-motivation than children who performed average or high in mathematical fluency in 1st grade. In addition, boys had significantly better mathematics related self-efficacy than girls. Especially girls with low-educated parents had lower mathematics related self-efficacy.

Mathematics related task-motivation and self-efficacy explained almost 30% of mathematical fluency when gender and parent's education were added to the model. When earlier mathematical fluency performance was added to the model it explained over 60%, but only gender and 2nd grade task-motivation had independent effects. Closer inspection to relations between gender revealed that task-motivation is not a valid predictor of mathematics fluency for girls in 2nd grade and for boys, task-motivation contributes significantly together with earlier mathematical fluency performance.

In this chapter, these results are discussed in the light of previous studies. Furthermore, limitations of this study, and future research directions are presented.

4.1 Development and differences of mathematics related self-efficacy and task-motivation

Prior studies have shown the importance of self-efficacy in academic achievement and especially in mathematics (Lee, 2009; Pajares & Miller, 1997; Pajares & Graham, 1999). This study showed that the general mathematics related self-efficacy increased in one-year period from 1st grade to 2nd grade, and there were no significant differences in development trends between levels. In addition, the levels of mathematics related self-efficacy were generally high already in the 1st grade spring. These results are encouraging.

Development of mathematics related self-efficacy of young children is not highly examined in earlier studies, but Phan (2012) found similar results that mathematics related self-efficacy beliefs increased in one-year period (from grade 3 to grade 4) with Australian children. Tuohilampi (2016) in other hand, found out that self-efficacy beliefs start to decline during transition to middle school. Furthermore, in Finland, Tuohilampi (2016) found out that as time goes by, middle-school mathematics related self-efficacy start to decrease, and this decrease is more dramatic with girls. Schunk and Pajares (2002) suggested various reasons for this decline in general: peers change, learning is more normative, there is more competition and less individual attention.

However, there are few matters on results of this study that require more attention. There were differences in the levels of mathematics related self-efficacy and task-motivation with different groups. Relatively large differences were in self-efficacy between mathematical fluency levels. Children in low mathematical fluency level had significantly weaker mathematics related self-efficacy than average or well-performing children. In general, high performing children had higher self-efficacy, whereas low performing children had lower self-efficacy. Also, average performing children had distinct difference in self-efficacy compared to well performing children. These findings are in line with Bandura's (1986) claim that self-efficacy beliefs predict academic outcomes. The strong relationship between mathematic performance and mathematics self-efficacy has been found out also in the previous studies of Hackett 1985, Pajares 1996 and

Ayotola & Adedeji 2009. In addition, according to Usher & Pajares (2008), self-efficacy degree- and type-distinctions between different levels of academic capability exist.

One of the most considerable findings is that boys had better mathematics related self-efficacy than girls as early as in 1st grade. In addition, girls with low-educated parents are in a greater risk to have low-self-efficacy, whereas boys had no differences in between parent's education level. Even though mathematics related self-efficacy differences between gender have been found earlier (e.g. Schunk & Lilly, 1984; Pajares & Miller 1994; Louis & Mistele, 2012, Hirvonen, 2012; Huang, 2012), this result is alarming because these gender differences are expected to start later, approximately in middle school (Usher & Pajares, 2008; Pajares, 2005a). Research on gender differences of self-efficacy among young elementary school children is rather low, but Wigfield & Eccles (2002) report same difference with 1st grade children, when Tuohilampi (2016) and Joët et al. (2011) have found gender difference in mathematics related self-efficacy as early as in 3rd grade.

In this study, mathematics related task-motivation showed no significant trend in development from 1st grade spring to 2nd grade spring. Previous studies have shown that during school career, mathematics related motivation (Gottfried et al., 2007; Gottfried et al., 2001) and enjoyment of mathematics (Tuohilampi 2016) decline significantly. However, these decreases are not found in early states of school or in kindergarten. Similar to the findings in this study, Viljaranta (2010) found out that there was no development in mathematics related task-motivation in kindergarten. These results differ from Aunola's et al. (2006) findings, where they reported that mathematics related task-motivation increased between 1st grade and 2nd grade, especially in those classrooms, where teacher's pedagogic goals emphasized motivation and development of self-concept.

Even though mathematics related task-motivation seems substantially static in early education, the decline later seems eminent and the effects on later choices in education (Gottfried et al., 2007; Hackett 1985). In addition, Gottfried et al. (2007) found that math-achievements corresponds with intrinsic motivation towards math, and early achievement in elementary school predicts later mathematics related motivation and achievements. In this study, clear differences were found in the level of task-motivation between low and high performing children. Viljaranta (2010) suggests that better level of mathematic skills increase task-motivation, because "easy" tasks are pleasant to perform, success leads to greater enjoyment, and these experiences also accumulate in time.

There were no significant differences in the level of task-motivation between genders. This result is similar to previous findings (Viljaranta, 2010; Wigfield & Eccles, 2002). However, gender differences in task-motivation are found to emerge later in the school career (Tuohilampi, 2016; Wigfield & Eccles, 2002). In mathematics related task-motivation, parent's education had no significant effect on level on task-motivation. Although, in previous studies parent's higher education has been found out to effect positively on mathematical performance (Brese & Mirazchiyski, 2010).

4.2 Associations of mathematics related self-efficacy's and task-motivations to mathematical fluency performance

The hierarchical regression analysis showed that mathematics related motivation and self-efficacy explained an average of 30% the math performance level in 1st grade and 2nd grade. In 1st grade, task-motivation seemed to have bit higher effect on math-performance, but by 2nd grade, self-efficacy explained more. When previous mathematical fluency is added to model 2, it explains over 60% over mathematical fluency performance. However, only gender and task-motivation in 2nd grade spring explains mathematical fluency in addition to previous performance.

In previous research, the relations of mathematical performance, motivation and self-efficacy are not explicit. Motivation, self-efficacy and mathematical performance has been studied in the context of high school and higher education (eg. Pajares and Miller, 1994; Zimmerman et.al 1992; Helming, 2013), but research lacks in the context of elementary school.

Self-efficacy is found to have an effect on academic achievement, but the relationship is also reverse (Pajares & Miller 1994; Pajares & Graham, 1999; Pajares & Schunk, 2001; Schunk & Pajares, 2002; Bong et al., 2012). In this study, when self-efficacy and task-motivation explained mathematical fluency performance only with gender and parent's education, self-efficacy was better predictor than task-motivation. However, when explaining continued with earlier fluency level, independent effect of self-efficacy disappeared.

In the case of motivation, there is evidence that performance affects to intrinsic motivation (Gottfried et al., 2007; Caron-Carrier et al. 2016; Viljaranta 2010), but there are different views concerning if it applies the other way around. Some studies have found that motivation is reciprocally linked to performance (Aunola et al. 2006; Viljaranta 2010; Gottfried et al., 2007; Hirvonen 2012), some say it directly explains performance (Murayama et al., 2013; Tossavainen, 2015; Viljaranta, 2010) and others claim that there is no evidence for such direction (Garon-Carrier et al., 2016). This study however indicates, that task-motivation does have an effect to mathematical fluency performance, but it seems contribute better with earlier mathematics fluency performance. Viljaranta (2010) suggests that task-motivation may have substantial effect early in the beginning of school, but that decreases due the importance of earlier knowledge that is needed to develop new skills in mathematics.

What is especially interesting, is that there were gender differences in how self-efficacy and task-motivation effects on mathematical fluency performance, and these directions also changed from 1st grade to 2nd grade. In 1st grade, with self-efficacy and task-motivation in the model, gender had independent effect toward girls. However, separate analysis for genders showed that girls mathematics related task-motivation was only slightly better predictor than boys equivalent in 1st grade. Situation changes in 2nd grade, where results suggest that girls task-motivation is not a valid predictor of mathematical fluency performance, whereas boys task-motivation had a significant effect to mathematical fluency performance when earlier fluency performance was added to model. In addition, it was found that girl's self-efficacy and task-motivation are not even moderately correlating in 1st and 2nd grade. This is quite interesting and so far, unique result suggesting, that there might be gender differences concerning how self-efficacy and task-motivation are linked, and associated with performance.

In this study, boys performed slightly, but statistically better in mathematics. This result differs from the previous research on this area: meta-analysis of contemporary studies on gender differences indicates that there is no gender difference in mathematics performance (Linberg, Hyde, Petersen & Linn, 2010). However, higher standard deviation of boys suggest that few high results might extend this difference in this study.

4.3 Limitations

There are few limitations in this study that should be considered, when attempting to generalize the findings of this study. First, children's self-efficacy and task-motivation are only two dimensions of motivation and self-concept, and it is important to consider, that there might be other affects concepts that influence more on mathematics than these two (see Nurmi, 2013). However, importance of these two are real, and promoting motivation and self-concept in general, works the same way than promoting task-motivation and self-efficacy.

This study was limited by questionnaire that inquired background questions from parents. First the questionnaire asked respondents highest education, and then the highest education of the other parent. It is not clear whether the answer is the answer of the child's father, mother, or other custodian. Because of this, for the parent's education grouping variable, parents (or respondent's) highest education was selected, and two groups of education level were made. This grouping style was chosen, because there were 18 children in the study who had one parent, and would have been excluded from the analyses if sum score variable for parent's education would have been used.

The question whether parent education should be used as a measure of the parent effect is also worth considering. In Finland, parent education does not necessarily contribute to the socio-economic status of the family: it could be, that a parent with a lower secondary education could have a company and earn much more than a parent with a doctoral-level education. Moreover, in Finland education is free. In contrast, in the USA, education is not free, and parent with a higher education level is likely to have a higher socio-economic status as well. Could socio-economic status of the family measure the effect from parents better?

There is also a question how reliable it is to study children's self-efficacy or task-motivation. In this study, the overall level of both were considerably high and normal distribution is difficult to achieve in such measures. According to Pajares (2005a) young children and especially boys, tend to overestimate their capabilities and in addition their self-efficacy beliefs might not accurate compared to actual skills. That might be because of the lack of capacity to observe what is needed to execute a task successfully or because young children self-efficacy mostly builds from vicarious sources like parent's beliefs and peer beliefs, rather than own mastery experiences (Schunk & Pajares, 2002). Although Bandura (1986) argues, that moderate overestimation of self-efficacy is useful, because it increases persistence and effort. It is still reasonable to consider how valid the children's own assessment of self-efficacy is and whether task-motivation (child's interest toward specific subject) is a better instrument measuring younger children affects towards subjects and to explain academic achievements.

However, regardless of accuracy of children believes of their own interests or capacities, measuring self-efficacy and task-motivation could be done more frequently to enhance validity in measurement. Then child's daily differences in affects could be standardized, measurement could be done more accurately and the same time, child learns more of self-evaluation.

It is unfortunate that the study did not include measures of arithmetic skills in 1st grade spring. Mathematical fluency was used as a skill variable, but it narrow measure of overall skills, and arithmetic skills would have improved the measure. In data-analysis, there were few questions in normal distribution of self-efficacy and specially in task-motivation, which might have an effect to results. However, when evaluating statistical power, type I and type II errors have been considered.

4.4 Future directions

Regarding matters that can be improved in relation to mathematics related self-efficacy and task-motivation, few matters in education environment are important to underline. Tuohilampi (2016) emphasizes in her dissertation how great learning achievements are useless, if positive bonds in learning and using mathematics are not created. Tuohilampi suggests giving more control of learning to students, allowing social interaction, and giving open-ended real-life problems for students to solve. (Tuohilampi, 2016). Linder, Smart and Cripps (2015) suggest three dimensions to teachers in improving mathematic motivation: establishing safe environment to learning, encourage to value mathematics and reducing external stress related to mathematics (e.g. value of exams).

For improving self-efficacy, it is crucial how previous performances are interpreted (Usher & Pajares, 2008) and there the atmosphere of classroom can be important. Aunola et al. (2006) emphasizes the role of teacher's pedagogical goals, such as improving children's motivation and self-concept. These goals show also in classroom, where teacher is more likely to organize learning situation containing positive feedback and optimal challenges which are important to enhance motivation and self-efficacy. First school years are in many ways shaping future experiences and therefore it is the right time to focus on children motivational development. (Viljaranta, 2010; Aunola et al., 2006.) Especially, the early difference in the level of task-motivation and self-efficacy between performance levels are important to consider and weigh in, because low-performing children in-particular need positive experiences in mathematics, in order to keep them interested in filling the gaps in learning.

Self-efficacy develops with encouragement (Usher & Pajares, 2008), but it is important to comprehend, that child recognizes empty praises. (Pajares, 2006). Pajares (2006) further suggest some ways to enhance young people's self-efficacy beliefs: emphasizing skill development rather than self-enhancement (raising competence through genuine success experiences), tailoring instructions to the student's capabilities (students are more likely to assess their progress to their own standards, rather than the progress of peers), praising rather effort and persistence than ability (some praising statements could tell that success is a matter of intellectual ability) and helping people learn to read their feelings (encourage them to discuss about negative feelings with teacher).

Aunola et al. (2006) found out that teachers' pedagogical goal emphasizing children's motivation or self-concept development was explaining the classroom variation in the trend of task motivation, whereas teachers pedagogical goal emphasizing mathematics did not. In addition, number of children in the class as well as the teachers' years of experience did not have statistical significance in predicting the variation (Aunola et al., 2006). The effect of teacher's pedagogical goals on children's academic motivation and school performance has also been found in previous studies (Ames, 1992; Ryan & Deci, 2000). It can be concluded, that the teacher's pedagogical goals orientation has a significant impact on children's task motivation and self-concept development, regardless of teaching experience or classroom size.

In terms of gender differences in mathematics related self-efficacy, it is alarming that these were found as early as in 1st grade. Usher & Pajares (2008) consider, that there still are stereotypical beliefs of what abilities genders hold and those show in explicit and implicit social messages from home, culture, education and media. Those messages effects on children self-efficacy beliefs and can have impact as far as in future occupation choice, so challenge for educator is to alter student's views of academic subjects (Schunk & Pajares, 2002). In addition, regular competitive manner to teach mathematics might be more suitable for boys, whereas girls tend to prefer more co-working in learning mathematics (Tuohilampi, 2016).

For future studies in this research area, factors like task difficulty, book-centered teaching and the lack of personal instruction are important things to consider with development of self-efficacy and task-motivation. Different learning games, which changes the level of difficulty according to the (increased) skill level of the child, could also be studied about how they build self-efficacy and motivation.

Longitudinal research of mathematics related motivation and self-efficacy could be beneficial to track the development and differences between groups. Gender differences in perceived self-efficacy and task-motivations needs more research, both in academic achievement and in mathematics, and especially in the context of elementary school. This study showed difference in how girls task-motivation in 2nd grade was hardly correlating with mathematical fluency and with self-efficacy, where boys had different result. It would be interesting to study this result more, because perhaps teachers should enhance differently girls' and boys' self-efficacy and task-motivation.

In conclusion, it is clear that affects, values and beliefs have a role on how mathematics are perceived and used. Because of this, it is necessary to help student build these dimensions, whereas improving their cognitive skills in mathematics.

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Appendix

Appendix 1

Means and standard deviation in self-efficacy in different groups

Group (N)	SE1 M (SD)	SE2 M (SD)
All (184)	3.88 (0.72)	4.19 (0.61)
Boys (89)	4.11 (0.62)	4.31 (0.59)
Girls (95)	3.67 (0.73)	4.08 (0.62)
LPE (105)	3.81 (0.77)	4.12 (0.59)
HPE (79)	3.98 (0.63)	4.28 (0.63)
LMF (44)	3.49 (0.77)	3.82 (0.65)
TMF (93)	3.84 (0.65)	4.18 (0.57)
HMF (47)	4.34 (0.49)	4.58 (0.39)
Boys LPE (51)	4.11 (0.62)	4.29 (0.56)
Boys HPE (38)	4.12 (0.63)	4.66 (0.26)
Girls LPE (54)	3.52 (0.78)	3.96 (0.57)
Girls HPE (41)	3.85 (0.61)	4.23 (0.65)
Boys LMF (23)	3.72 (0.73)	3.96 (0.71)
Boys TMF (40)	4.08 (0.66)	4.30 (0.52)
Boys HMF (26)	4.50 (0.38)	4.65 (0.31)
Girls LMF (21)	3.24 (0.74)	3.66 (0.55)
Girls TMF (53)	3.65 (0.68)	4.08 (0.62)
Girls HMF (21)	4.15 (0.56)	4.49 (0.47)
LPE-LMF (27)	3.43 (0.87)	3.77 (0.73)
LPE-TMF (54)	3.80 (0.70)	4.11 (0.47)
LPE-HMF (24)	4.24 (0.55)	4.53 (0.37)
HPE-LMF (17)	3.58 (0.59)	3.88 (0.52)
HPE-TMF (39)	3.87 (0.60)	4.26 (0.69)

HPE-HMF (23)	4.45 (0.40)	4.62 (0.42)
Boys-LPE-LMF (14)	3.84 (0.75)	4.04 (0.76)
Boys-LPE-TMF (26)	4.10 (0.59)	4.28 (0.43)
Boys-LPE-HMF (11)	4.47 (0.35)	4.64 (0.39)
Boys-HPE-LMF (9)	3.53 (0.72)	3.82 (0.65)
Boys-HPE-TMF (14)	4.05 (0.43)	4.34 (0.69)
Boys-HPE-HMF (15)	4.53 (0.41)	4.66 (0.27)
Girls-LPE-LMF (27)	3.42 (0.87)	3.48 (0.58)
Girls-LPE-TMF (54)	3.81 (0.70)	3.97 (0.47)
Girls-LPE-HMF (24)	4.24 (0.56)	4.45 (0.34)
Girls-HPE-LMF (17)	3.58 (0.59)	3.96 (0.36)
Girls-HPE-TMF (39)	3.88 (0.60)	4.21 (0.70)
Girls-HPE-HMF (23)	4.45 (0.40)	4.55 (0.64)

Note. SE = Self-Efficacy, TM=Task-Motivation, 1 = 1st grade spring, 2= 2nd grade spring, LPE=Low Parent's Education, HPE= High Parents Education, LMP= Low Mathematical Fluency, TMP= Typical Mathematical Fluency, HMP= High Mathematical Fluency.

Appendix 2

Table 8

Means and standard deviation in task-motivation, in different levels

Group (N)	TM1 M (SD)	TM2 M (SD)
All (184)	3.81 (1.20)	3.79 (1.22)
Boys (89)	3.95 (1.19)	3.85 (1.25)
Girls (95)	3.68 (1.20)	3.74 (1.18)
LPE (105)	3.78 (1.23)	3.81 (1.18)
HPE (79)	3.85 (1.17)	3.76 (1.27)
LMF (44)	3.00 (1.21)	3.23 (1.16)
TMF (93)	3.84 (1.15)	3.84 (1.22)
HMF (47)	4.50 (0.77)	4.21 (1.07)
Boys LPE (51)	3.90 (1.24)	3.98 (1.21)
Boys HPE (38)	4.02 (1.14)	3.67 (1.23)
Girls LPE (54)	3.78 (1.23)	3.65 (1.13)
Girls HPE (41)	3.70 (1.29)	3.84 (1.25)
Boys LMF (23)	3.03 (1.40)	3.03 (1.21)
Boys TMF (40)	4.04 (1.06)	4.07 (1.16)
Boys HMF (26)	4.63 (0.49)	4.23 (1.14)
Girls LMF (21)	2.98 (1.00)	3.46 (1.08)
Girls TMF (53)	3.69 (1.21)	3.67 (1.25)
Girls HMF (21)	4.34 (1.01)	4.17 (1.01)
LPE-LMF (27)	3.04 (1.14)	3.23 (1.20)
LPE-TMF (54)	3.81 (1.21)	3.93 (1.12)
LPE-HMF (24)	4.54 (0.88)	4.19 (1.08)
HPE-LMF (17)	2.94 (1.36)	3.24 (1.12)
HPE-TMF (39)	3.89 (1.09)	3.72 (1.35)

HPE-HMF (23)	4.45 (0.66)	4.22 (1.09)
Boys-LPE-LMF (14)	3.21 (1.36)	3.10 (1.27)
Boys-LPE-TMF (26)	3.94 (1.21)	4.37 (0.92)
Boys-LPE-HMF (11)	4.70 (0.46)	4.18 (1.28)
Boys-HPE-LMF (9)	2.74 (1.50)	2.92 (1.18)
Boys-HPE-TMF (14)	4.24 (0.70)	3.50 (1.37)
Boys-HPE-HMF (15)	4.58 (0.52)	4.27 (1.07)
Girls-LPE-LMF (27)	2.87 (0.86)	3.38 (1.14)
Girls-LPE-TMF (54)	3.69 (1.23)	3.52 (1.16)
Girls-LPE-HMF (24)	4.41 (1.12)	4.20 (0.92)
Girls-HPE-LMF (17)	3.16 (1.24)	3.58 (1.01)
Girls-HPE-TMF (39)	3.69 (1.22)	3.84 (1.34)
Girls-HPE-HMF (23)	4.25 (0.87)	4.13 (1.20)

Note. SE = Self-Efficacy, TM=Task-Motivation, 1 = 1st grade spring, 2= 2nd grade spring, LPE=Low Parent's Education, HPE= High Parents Education, LMP= Low Mathematical Fluency, TMP= Typical Mathematical Fluency, HMP= High Mathematical Fluency.

Appendix 3

MODEL 1 : Means, Standard Deviation and Pearson correlations of variables used in hierarchical regression analysis

		1	2	3	4	5
1	Mathematical fluency 1GS	1.00				
2	Gender	-.023	1.00			
3	Parents education group	-.084	.005	1.00		
4	Self-Efficacy 1GS	.424 ***	-.312 ***	.120	1.00	
5	Task-Motivation 1GS	.419***	-.113	.029	.255***	1.00
	Mean	8.12	0.52	0.43	3.88	3.81
	SD	3.28	0.50	0.50	0.72	1.20

*Note: *** p < .001. 1GS= 1st grade spring, 2GS= 2nd grade spring. Gender: 0=boy, 1=girl. Parents education group: 0=lower, 1=higher.*

MODEL 2: Means, Standard Deviation and Pearson correlations of variables used in hierarchical regression analysis

		1	2	3	4	5
1	Mathematical fluency 2GS	1.00				
2	Gender	-.179	1.00			
3	Parents education group	-.098	.005	1.00		
4	Self-Efficacy 2GS	.480***	-.192**	.130*	1.00	
5	Task-Motivation 2GS	.341***	-.045	-.022	.356***	1.00
6	Mathematical fluency 1GS	.764***	-.023	.084	.494***	.278***
	Mean	12.32	0.52	0.43	3.88	3.81
	SD	5.57	0.50	0.50	0.72	1.20

*Note: * p < .05, **p < .01, *** p < .001. 1GS= 1st grade spring, 2GS= 2nd grade spring. Gender: 0=boy, 1=girl.*

Parents education group: 0=lower, 1=higher

Appendix 4 – Correlation separately for genders

MODEL 1 : Means, Standard Deviation and Pearson correlations of variables used in hierarchical regression analysis separately for genders

BOYS	1	2	3	4	GIRLS	Girls Mean SD
1 Mathematical fluency 1GS	1.00	-.016	.439***	.391***	1 Mathematical fluency 1GS	8.14 2.93
2 Parents education group	-.168	1.00	.225*	.013	2 Parents education group	0.43 0.50
3 Self-Efficacy 1GS	.458 ***	.007	1.00	.121	3 Self-Efficacy 1GS	3.67 0.73
4 Task-Motivation 1GS	.449***	.048	.375***	1.00	4 Task-Motivation 1GS	3.68 1.21
Boys Mean SD	8.29 3.81	0.43 0.50	4.11 0.62	3.95 1.19		

*Note: *** $p < .001$. 1GS= 1st grade spring, 2GS= 2nd grade spring. Gender: 0=boy, 1=girl.*
Parents education group: 0=lower, 1=higher.

MODEL 2 : Means, Standard Deviation and Pearson correlations of variables used in hierarchical regression analysis separately for genders

BOYS	1	2	3	4	5	GIRLS	Girls Mean SD
1 Mathematical fluency 2GS	1.00	.072	.440***	.221*	.751***	1 Mathematical fluency 1GS	11.36 4.37
2 Parents education group	.125	1.00	.212*	.081	-.016	2 Parents education group	0.43 0.50
3 Self-Efficacy 2GS	.499 ***	.045	1.00	.236*	.486	3 Self-Efficacy 1GS	4.08 0.62
4 Task-Motivation 2GS	.427***	-.124	.481***	1.00	.230*	4 Task-Motivation 1GS	3.74 1.18
5 Mathematical fluency 1GS	.787***	.168	.521***	.316***	1.00	5 Mathematical fluency 1GS	8.14 2.93
Boys Mean SD	13.35 6.49	0.43 0.50	4.31 0.59	3.85 1.25	8.29 3.81		

*Note: *** $p < .001$. 1GS= 1st grade spring, 2GS= 2nd grade spring. Gender: 0=boy, 1=girl.*
Parents education group: 0=lower, 1=higher.