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Kikas, Eve

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EDITED BY
Catherine Ratelle,
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Sarah Schulze,
Technical University Dortmund, Germany
Natalia Suárez,
University of Oviedo, Spain

*CORRESPONDENCE
Eve Kikas
ekikas@tlu.ee

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# Parental homework-help profiles throughout grades 6 – 9: Relations to motivation and mathematics skills

Eve Kikas[1]*, Kaja Mädamürk[1,2] and Gintautas Silinskas[3]

[1]School of Natural Sciences and Health, Tallinn University, Tallinn, Estonia, [2]Faculty of Educational Sciences, University of Helsinki, Helsinki, Finland, [3]Department of Psychology, University of Jyväskylä, Jyväskylä, Finland

This study aimed to examine how parental profiles during homework help (supportive versus controlling) for children in Grades 6 and 9 change over time and relate to children's motivation and math skills. Participants included 719 mother–child dyads. Children's perceptions of parental help and math skills were assessed in both grades; children's math-related self-concept, interest, and mother-rated task persistence were assessed only in Grade 6. Three similar profiles of parental help appeared in both grades. Most mothers and children belonged to the *Average support and control* profile (around 60% in both grades); 29–33% belonged to the *Average support, high control* profile; and 8–11% belonged to the *Low support, below average control* profile. Profiles differed based on children's self-concept, task persistence, and math skills in Grade 6. Transitions of parental homework help predicted children's math skills in Grade 9. These findings help to conceptualize parental homework help as a multidimensional construct that may manifest in three different profiles which differentially relate to the child's skills and motivation.

KEYWORDS

**latent profiles, mathematics homework help, task persistence, self-concept, interest, mathematics skills**

## Introduction

Learning in middle school is challenging, and many children experience a decline in school performance and motivation (Scherrer and Preckel, 2019). The amount and complexity of homework also increases (Hill and Tyson, 2009). Homework completion is a complex process affected by numerous integrated factors (Trautwein et al., 2006). One of these factors is parental homework help, a part of parental home-based involvement which declines as students mature. However, a considerable percentage of parents continue helping their children throughout middle school (Silinskas and Kikas, 2019a). By providing help with homework, parents typically hope to improve their children's learning outcomes, but empirical studies have shown that these attempts are not always successful, particularly in middle school (Cooper et al., 2000; Patall et al., 2008). Further research is needed to specifically account for the increased academic demands and changes in psychological processes and behaviors

students experience during middle school (Hill and Tyson, 2009; Crone and Steinbeis, 2017).

The effectiveness of parental practices may be related to the type of help (supportive vs. controlling; Pomerantz et al., 2007; Dumont et al., 2012). Historically, supportive and controlling help have been analyzed with variable-oriented methods. However, parents may combine both types of help and — due to differences in beliefs, practices, or skills — may react differently to their child's success or failure. Children may also react differently to different patterns of parental help. Such non-linear relations are best examined using analyzes that account for intra-individual variation within a system of variables (Bergman et al., 2003). Person-oriented approaches may provide a better understanding of the role of different parental help patterns. When accounting for child- and parent-related factors, such approaches may also enrich our understanding of the development of parental help during middle school. Thus, the first aim of the current study was to examine parental help profiles (supportive versus controlling) and how they change throughout middle school (Grades 6–9).

Other important factors affecting students' homework processes include students' skills and motivation (Trautwein et al., 2006). In addition to parental influences on homework completion, parents may also modify their practices in response to children's motivation and academic outcomes. These effects have been studied less (for exceptions, see Silinskas et al., 2013; Dumont et al., 2014). To our best knowledge, no studies have examined relations between children's motivation, skills, and parental help profiles. Thus, our second aim was to examine how children's motivation, skills, and learning behavior while completing homework predict changes in parental help profiles throughout middle school.

The subject of math was chosen because math typically includes homework that requires help from parents (Kitsantas et al., 2011). Declines in competence beliefs and intrinsic motivation during middle school are particularly evident in math (Gottfried et al., 2009). Earlier studies have reported weak interrelations among parental help, math skills, and motivation (Silinskas and Kikas, 2019a), suggesting the existence of different combinations of parental support and control during homework help. Thus, this study expands upon earlier analyzes using a person-oriented approach to examine parental help profiles, children's math skills, and motivation at the end of middle school in Estonia (Grades 6–9; age 12–16 years).

## Supportive and controlling help with homework in middle school

Supportive practices emphasize a child's independent activities and initiatives: parents respond to a child's requests and/or behavior, provide necessary help, and discuss tasks and solutions. Controlling help involves parental efforts to lead a child toward a particular outcome by giving commands and directives (Pomerantz et al., 2007; Dumont et al., 2012). Supportive practices consider personal characteristics and environmental affordances. Parents enhance development and learning when providing adequate help such that tasks are within the range of the child's abilities (cf. Leith et al., 2018). This contrasts with controlling help, in which parents may not allow their child to be challenged or may fail to recognize their child's ability level. Supportive help considers a child's need for autonomy and competence (Ryan and Deci, 2020). Scaffolding techniques may be used to support children's motivation (Mermelshtine, 2017).

In middle school, parental support (including help with homework) tends to change over time due to different skills students need to acquire, improving reasoning skills, and the importance of discussions and negotiations in adolescence (Hill and Tyson, 2009). Compared to primary school, parents of middle schoolers are less directly involved with homework but are more likely to support their child's autonomy (Cooper et al., 2000). Still, studies have shown stability in the use of controlling and supportive practices (Silinskas and Kikas, 2019a). In addition, children's perceptions of supportive and controlling help are positively related (Silinskas and Kikas, 2019a,b). Thus, depending on a task, parents may modify their behavior, combine both types of help, or switch between them. For instance, a parent may start by checking homework but, in response to a child's question, proceed with discussions.

Most prior studies have shown that supportive help is related to higher achievement (Pomerantz et al., 2007; Patall et al., 2008), but some math-specific studies have found no such correlation (Levpušček and Zupančič, 2009; Karbach et al., 2013; Silinskas and Kikas, 2019a). Conversely, controlling help tends to be negatively associated with achievement (Patall et al., 2008; Levpušček and Zupančič, 2009; Karbach et al., 2013; Silinskas and Kikas, 2019a).

## Effects of children's skills and motivation on parental homework help

Trautwein's homework model (2006) revealed relationships between parental homework help and children's gender, skills, and conscientiousness. Moreover, while children's persistence and expectancy-value components of motivation (Eccles and Wigfield, 2020) are considered independent from parental help, children's motivation may also affect and modify parental practices (Pomerantz and Eaton, 2001; Silinskas and Kikas, 2019b).

Studies have shown that, when a child is struggling in school, parents tend to increase control and explicit teaching (Silinskas et al., 2013; Dumont et al., 2014; Hoglund et al., 2015; Silinskas and Kikas, 2019a,b). Parents may also modify their behavior according to a child's age. For instance,

Silinskas and Kikas (2019a) found that poor math skills in Grade 3 were related to higher maternal control in Grade 6, while poor math skills in Grade 6 were related to higher support in Grade 9. Parents may also respond to children's academic outcomes by combining supportive and controlling strategies. Therefore, this study examines the effects of math skills on parental homework-help profiles.

It may be argued that motivational effects on parental homework help are related to how engaged and persistent parents perceive their children to be. These effects have been studied less, and findings are not consistent with findings concerning children's skills. Task persistence – effortful behavior even when tasks become difficult – is visible for others as an indicator of learning motivation (Zhang et al., 2011). A study in primary school showed that parents tend to respond to children's low task-persistent behavior with increasing control (Kikas and Silinskas, 2016). In middle school, however, this effect was only found for boys (Silinskas and Kikas, 2019b). Simiarly, Dumont and colleagues (2014) found that parents provided higher control in Grade 7 to students who showed higher reading effort in Grade 5.

Other motivational constructs investigated in this study include children's math-related self-concept and interest. Students with high math self-concept — the belief in one's ability to complete math tasks successfully (closely related to self-efficacy; Bong and Skaalvik, 2003) — tend to put more effort in learning and completing homework (Dettmers et al., 2010; Katz et al., 2014; Xu, 2020). Math-related interest — i.e., enjoyment of math — is accompanied by positive emotions, attention, and task-persistent learning behavior (Frenzel et al., 2012; Eccles and Wigfield, 2020). Higher math self-concept and interest are related to better achievement (Marsh et al., 2005). Higher homework self-concept and interest are also related to higher effort when completing homework (Trautwein et al., 2006).

Students with higher self-concept and interest may also be more capable of ignoring possible distractors during homework (e.g., friends, TV; Galla et al., 2018). Children with low self-concept and interest may receive controlling help from parents. For example, Silinskas and Kikas (2019b) showed that math self-concept in Grade 3 negatively predicted parental control three years later. However, no studies have examined the possible effects of self-concept and interest on parental homework-help profiles.

## Aims and hypotheses

The main aim of the current study was to examine child-perceived profiles of parental homework help (further: *parental profiles*) in Grades 6 and 9, as well as the profiles' changes, and relation to children's motivation and math skills. We used person-oriented analyzes to elaborate on earlier variable-oriented findings regarding the role of different forms of parental help. The study was carried out in Estonia, where students have demonstrated strong math skills (OECD, 2019) but are also subject to a high homework load (6.9 h per week; OECD, 2014). In Grades 6 and 9, Estonian students have to complete a national math test. Due to intensive exam preparations and significant homework loads, students often request help from parents. The main research questions (RQ) and hypotheses are as follows.

First (RQ1), what types of latent profiles based on child-reported parental help exist, and how stable are they? What changes occur between Grades 6 and 9? We expected to find adaptive and non-adaptive profiles in both grades. Adaptive profiles show higher parental support and lower control, while non-adaptive profiles show lower support and higher control. The names "adaptive" and "non-adaptive" are based on earlier findings showing that higher support and lower control tend to be related to better academic outcomes (Pomerantz et al., 2007; Patall et al., 2008; Karbach et al., 2013). As earlier studies have indicated that parents tend to be more supportive at the end of middle school (Cooper et al., 2000; Hill and Tyson, 2009), we expected to find more adaptive profiles in Grade 9. We expected that most parents would stay in the same or similar profiles, but that several would also move from adaptive to non-adaptive profiles, and vice versa. To this end, we investigated latent transitions between profiles from Grades 6–9.

Earlier variable-oriented studies have shown differences in parental support and control related to parental education level and child gender. While higher parental education has been shown to be related either with higher (Moroni et al., 2015) or lower (Silinskas and Kikas, 2019b) homework support, studies have consistently shown that, compared to boys, girls are less frequently controlled and more frequently provided autonomy by their parents (Dumont et al., 2012). Thus, we asked two questions (RQ2a): How do parental profiles and profile transitions differ in relation to maternal educational level? How do parental profiles and profile transitions differ in relation to the child's gender?

(RQ2b) Based on parental profile, how do students in Grade 6 differ in their motivation and math skills? In addition, do motivation and math skills predict adaptive and non-adaptive parental profile transitions between throughout middle school and in Grade 9 profiles?

(RQ2c) How do students' Grade 6 parental profiles and adaptive and non-adaptive transitions predict math skills in Grade 9 after controlling for Grade 6 math skills?

## Materials and methods

### Participants and procedure

Data was taken from a large-scale longitudinal study which followed children from kindergarten through Grade 9. Participants were selected from kindergartens throughout Estonia. In Grades 1 and 6, classmates were also included.

Parents were sent invitation letters and asked to provide written consent for themselves and their children to participate in the study. Only children with written consent were included in the study (93%). Twenty-eight Estonian schools (52 classrooms) participated from both urban and rural areas.

The present study used data from children who reported that their parents helped them with math homework in Grades 6 and 9 and whose mothers answered questionnaires in both grades. As a departure from earlier published studies, we included children's math-related interest and carried out person-oriented analyzes. The children's sample ($N$ = 719; 378 boys) was highly homogeneous in terms of ethnic and cultural backgrounds. All schools and students were Estonian speaking. Parental education was divided into three groups: 5.7% of mothers belonged to a low-education group (less than high school education); 44.9% belonged to a medium-education group (high school education); and 28.4% belonged to a high-education group (university education). 21% did not report their education.

## Measures

### Perceived parental help: support versus control

Children were asked about the ways their parents helped them with math homework in Grades 6 and 9. Questions were developed based on previous studies (Dumont et al., 2012, 2014) and had been used in other studies (Silinskas and Kikas, 2019a,b). The questionnaire measured two dimensions of perceived parental help with math homework: support and control. Dimensions were assessed using four questions each, and responses were provided on a four-point scale, ranging from 1 (completely disagree) to 4 (completely agree). Information on the factor structure and exact items with factor loadings are presented in **Appendix Table A1**, and model fit indices in Table A2. CFA models had an acceptable model fit for both grades.

### Math self-concept

Math self-concept was assessed in Grade 6 using four items (Eccles et al., 2005; Dumont et al., 2012). Children rated their math self-concept on a 5-point scale (1 = does not apply to me at all; 5 = applies to me to a great extent). The CFA showed that the proposed factor structure fit the data well (see **Appendix Tables A1** and **A2**).

### Math-related interest

Math-related interest was assessed in Grade 6 using three items (Eccles et al., 2005). Children rated their interest on the same 5-point rating scale. The information on the factor structure and the exact items with factor loadings is presented in **Appendix Table A1**. The CFA with three statements of math interest showed a saturated model with no modifications (see **Appendix Table A2**).

### Task Persistence

Mothers of students in Grade 6 rated their children's homework-related task-persistent behavior on the Behavioral Strategy Rating Scale (Zhang et al., 2011). This scale has been used in earlier studies (e.g., Silinskas and Kikas, 2019a,b). Mothers were asked to consider how their children typically behave when completing homework and to rate this behavior on a 5-point scale (1 = not at all; 5 = to a great extent). Questions dealt with the degree to which children engage in active and persistent behaviors. The CFA showed that the proposed factor structure fit the data well (see **Appendix Tables A1** and **A2**).

### Math skills

Math tests were developed according to the Estonian national curriculum (Estonian Government, 2011/2021). The tests tapped both arithmetic and word problem-solving skills to include eight calculations (addition, subtraction, multiplication, and division) and five word problems in Grade 6, and seven calculations (including fractions) and 12 word problems in Grade 9. The sums of correct answers were used as scores.

## Analysis strategy

Our data were not missing completely at random: Little's MCAR test (Little, 1988): $\chi^2 = 149.726$, $df = 110$, $p = 0.007$. We used full-information maximum likelihood (FIML) parameter estimation with standard errors, which is robust to non-normally distributed and non-independent observations when used with TYPE = COMPLEX (MLR; Muthén and Muthén, 1998–2017; Yuan and Bentler, 2000). FIML is a standard procedure in M*plus*, which allows all available data to be used without imputing data. Because the data were hierarchical in nature (i.e., children nested within teachers), we calculated intra-class correlations (ICC) for the studied variables. The ICCs of all main studied variables ranged from 0.01 to 0.11 ($p > 0.05$ to $p < 0.05$). Since part of the variance in the observed variables was due to differences between teachers and children in class, we used the "complex" function of M*plus* in all subsequent analyzes (Muthén and Muthén, 1998–2017). When applying the TYPE = COMPLEX function, we used classroom ID as a clustering variable to compute corrected standard errors and obtain tests of model fit, where the nested structure of the data was taken into account. There were 52 clusters (classes) with an average cluster size of 13.83.

Our main aim was to examine latent profiles based on perceptions of parental support and control. M*plus* software version 8 (Muthén and Muthén, 1998–2017) was used for statistical analysis. To answer our first research question, we used latent profile analyses (LPA) separately for Grades 6 and 9 and latent transition analysis (LTA) for profiles across Grades 6 and 9. The following criteria were used to select the final number of latent profiles: (1) the fit of the model; (2) the number

of children assigned to a latent profile; and (3) the practical usefulness, theoretical justification, and interpretability of the solution (Muthén, 2003). One thousand random starting values were used to avoid local maxima and estimation problems (see also Hipp and Bauer, 2006). The fit of the model was evaluated using four indices: (1) the Akaike information criterion (AIC); (2) the adjusted Bayesian information criterion (ABIC); (3) the Lo-Mendell Rubin adjusted likelihood ratio test (ALMRT; Lo et al., 2001); and (4) the Vuong-Lo-Mendell-Rubin Likelihood Ratio test (VLMRT). Lower AIC and ABIC values indicate a better model, and significant ALMRT and WLMRT values suggest the need to choose a higher number of groups. Entropy was used to evaluate classification quality; higher entropy values indicate clearer classification (Muthén, 2003).

To answer RQ2a, we used a chi-square test to investigate whether parental profiles differed according to maternal educational level and child gender. To answer RQ2b, an analysis of variance (ANOVA) and multinomial logistic regression was used to investigate the extent to which latent profiles and transitions would be predicted by children's motivation and math skills. Finally, to answer RQ2c, we used path analyzes to predict math skills in Grade 9 by the dichotomized Grade 6 parental profile and transitions variables.

# Results

Descriptive data for the sample, including scale reliabilities, are presented in **Appendix Table B1**, and correlations between all variables are presented in **Appendix Table B2**.

## Latent profile analysis and latent transition analysis of parental homework help (RQ1)

To examine which patterns of latent profiles exist with regard to children's perceived parental help in Grades 6 and 9, we first executed a series of latent profile analyzes using two variables of parental homework help: perceived support and perceived control. **Tables 1**, and **2** present fit indices and proportions of children in each latent profile for the LPA solutions in Grades 6 and 9, respectively. LPA indicated that models with either three or four profiles had good model fit at both time points. Based on these results, latent transition analysis (LTA) was conducted. The LTA model with three profiles at both time points had entropy.69 and four profiles at both time points had entropy.71. Both three- and four-profile models included similar profile types. However, the four-profile model also included two profiles that both had a close-to-average level of support and control. Thus, we preferred the three-profile model.

TABLE 1 Latent profile analysis fit indices for 1–7 latent profiles in grade 6 ($N$ = 624).

| Criterion | One profile | Two profiles | Three profiles | Four profiles | Five profiles |
|---|---|---|---|---|---|
| Log-likelihood | −1363.19 | −1274.972 | −1216.799 | −1175.722 | −1138.596 |
| Parameters | 4 | 7 | 10 | 13 | 16 |
| AIC | 2734.38 | 2563.95 | 2453.60 | 2377.44 | 2309.19 |
| BIC | 2752.12 | 2595.00 | 2497.96 | 2435.11 | 2380.17 |
| ABIC | 2739.42 | 2572.77 | 2466.21 | 2393.84 | 2329.37 |
| Entropy | | 0.90 | 0.87 | 0.89 | 0.92 |
| VLMRT ($p$ value) | | 0.00 | 0.02 | 0.00 | 0.35 |
| ALMRT ($p$ value) | | 0.00 | 0.02 | 0.00 | 0.37 |
| Profile 1 (%) | | 90 | 28 | 3 | 8 |
| Profile 2 (%) | | 10 | 5 | 8 | 24 |
| Profile 3 (%) | | | 67 | 61 | 3 |
| Profile 4 (%) | | | | 28 | 17 |
| Profile 5 (%) | | | | | 48 |

AIC, Akaike information criterion; BIC, Bayesian information criterion; ABIC, adjusted Bayesian information criterion; VLMRT, Vuong-Lo-Mendell-Rubin Likelihood Ratio test; ALMRT, Lo-Mendell-Rubin adjusted likelihood ratio test.

TABLE 2 Latent profile analysis fit indices for 1–7 latent profiles in grade 9 ($N$ = 518).

| Criterion | One profile | Two profiles | Three profiles | Four profiles | Five profiles |
|---|---|---|---|---|---|
| Log-likelihood | −1116.717 | −1049.043 | −1007.289 | −961.267 | −933.656 |
| Parameters | 4 | 7 | 10 | 13 | 16 |
| AIC | 2241.44 | 2112.09 | 2034.58 | 1948.53 | 1899.31 |
| BIC | 2258.43 | 2141.84 | 2077.08 | 2003.78 | 1967.31 |
| ABIC | 2245.74 | 2119.62 | 2045.34 | 1962.52 | 1916.53 |
| Entropy | | 0.83 | 0.89 | 0.85 | 0.87 |
| VLMRT ($p$ value) | | 0.00 | 0.10 | 0.01 | 0.11 |
| ALMRT ($p$ value) | | 0.00 | 0.11 | 0.01 | 0.13 |
| Profile 1 (%) | | 19 | 31 | 11 | 11 |
| Profile 2 (%) | | 81 | 6 | 51 | 27 |
| Profile 3 (%) | | | 63 | 32 | 1 |
| Profile 4 (%) | | | | 6 | 51 |
| Profile 5 (%) | | | | | 10 |

AIC, Akaike information criterion; BIC, Bayesian information criterion; ABIC, adjusted Bayesian information criterion; VLMRT, Vuong-Lo-Mendell-Rubin Likelihood Ratio test; ALMRT, Lo-Mendell-Rubin adjusted likelihood ratio test.

Three profiles in both grades were quite similar (see **Figure 1**). The largest group of students at both time points tended to report *Average support and control* (59% of students in Grade 6; 60% in Grade 9). Another group was formed from students who tended to report *Low support and below average control* (8% in Grade 6; 11% in Grade 9). A third group included students who reported *Average support but high control* (33% in Grade 6; 29% in Grade 9).

With respect to the same research question, results of LTA indicated that most students tended to stay in similar

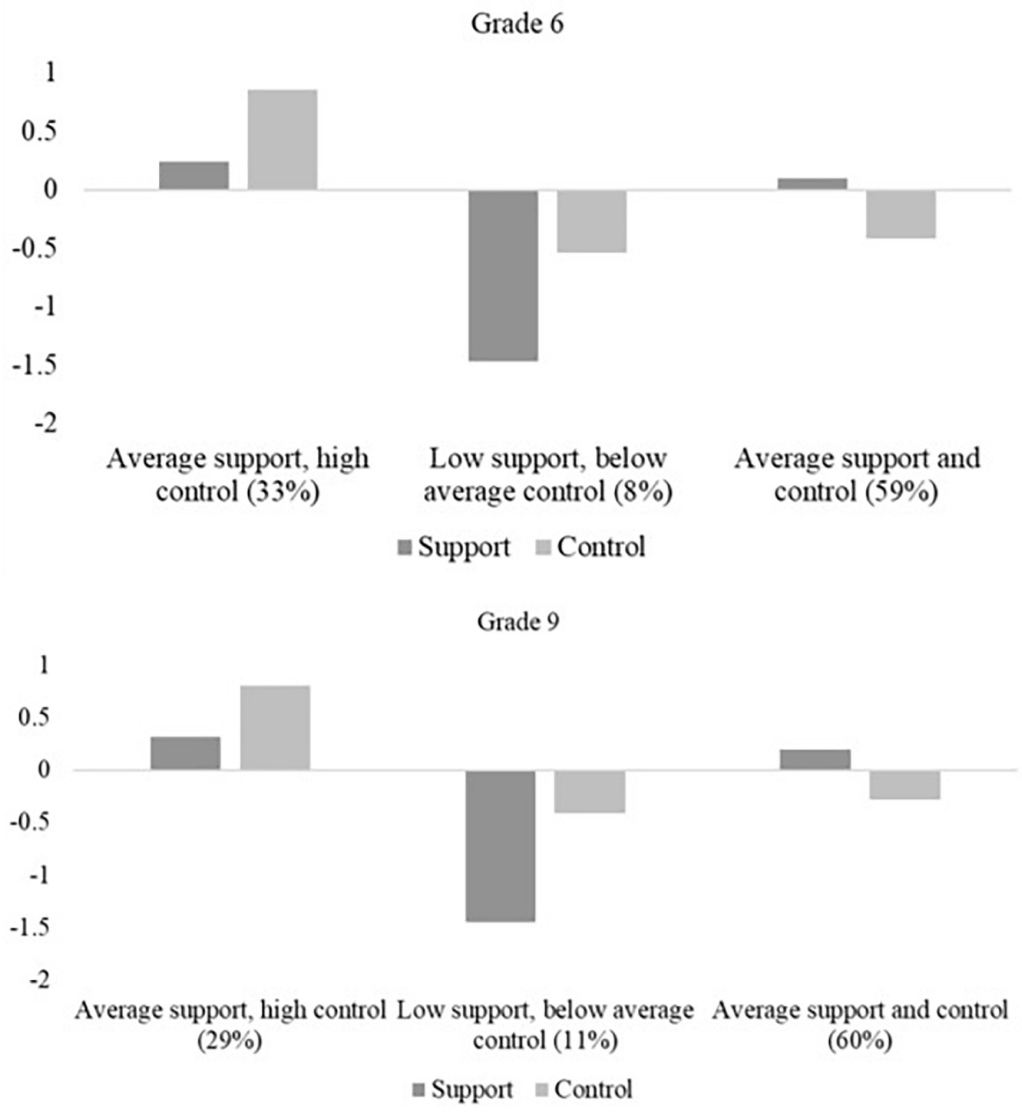


FIGURE 1
Standardized means of the latent parental-help profiles in grades 6 and 9.

profiles over time (see **Table 3** and **Figure 2**). Latent transition probabilities (LTP) between similar profiles in both grades were.66–0.80. Still, some students changed their profiles over time. Several students who belonged to the *Low support, below average control* profile moved to the *Average support and control* group (LTP = 0.24). In addition, some students who reported *Average support but high control* in Grade 6 moved to *Average support and control* (LTP = 0.29).

We also categorized latent profile transitions into three main transition groups based on children's most probable latent class membership in both grades:

1. *Combined group of low control and transition to low control* (71% of the students); i.e., students who either tended to stay low or average control group or change from other groups to the Grade 9 *Average support and control* or *Low support, below average control* profile groups;
2. Stable high control (26% of students); i.e., students who tended to move from the Grade 6 Average support, high control profile to the Grade 9 Average support, high control profile group;
3. Change to high control (3% of students); i.e., students who tended to move from Grade 6 profiles with low or average control to Grade 9 Average support, high control profile group.

Accordingly, most children tended to perceive low control through both time points, while some experienced high control

TABLE 3 Latent transition probabilities between grades 6 and 9.

| Grade 6 | Grade 9 | | |
|---|---|---|---|
| | Average support, high control (29%) | Low support, below average control (11%) | Average support and control (60%) |
| Average support, high control (33%) | 0.66 | 0.05 | 0.29 |
| Low support, below average control (8%) | 0.10 | 0.66 | 0.24 |
| Average support and control (59%) | 0.08 | 0.12 | 0.80 |

in both grades and others changed to the high control group in Grade 9.

## Maternal education and children's gender in parental homework-help profiles (RQ2a)

There were no differences in profiles related to maternal education level in either grade [$\chi^2(4, N = 568) = 4.13$, $p > 0.05$; $\chi^2(4, N = 568) = 2.52$, $p > 0.05$], nor were differences found in transition groups [$\chi^2(4, N = 568) = 5.25$, $p > 0.05$].

We also examined whether there was a gender imbalance in parental profiles and transition profiles. In Grade 6, more girls were in the *Low support, below average control* group, while more boys were in the *Average support, high control* group [$\chi^2(2, N = 719) = 7.63$, $p < 0.05$]. In Grade 9, more boys were in the *Average support, high control* group [$\chi^2(2, N = 719) = 8.85$, $p < 0.05$]. Similarly, more girls were in the *Low control and transition to low control* transition group, while more boys were in the *Stable high control* transition group [$\chi^2(2, N = 719) = 7.48$, $p < 0.05$].

## Motivational factors and math skills related to perceived parental homework-help profiles and transitions (RQ2b)

We investigated whether Grade 6 parental profiles differed regarding self-concept, interest, task persistence, and math skills (Table 4). One-way ANOVA results indicated that groups differed regarding self-concept [$F(2, 635) = 21.18$, $p < 0.01$, $\eta^2 = 0.06$], task persistence [$F(2, 569) = 13.33$, $p < 0.01$, $\eta^2 = 0.05$], and math skills [$F(2, 649) = 12.11$, $p < 0.01$, $\eta^2 = 0.04$]. More precisely, *post hoc* tests indicated that the *Average support and control* group ($M = 3.55$, $SD = 1.00$) tended to have higher self-concept than the *Average support, high control* group ($M = 3.00$, $SD = 0.95$), as well higher task persistence ($M = 3.69$, $SD = 0.83$ and $M = 3.32$, $SD = 0.84$) and math skills ($M = 8.59$, $SD = 2.21$ and $M = 7.64$, $SD = 2.25$). The *Low support, below average control* group also tended to have higher task persistence ($M = 3.78$, $SD = 0.83$) than the *Average support, high control* group. There were no differences regarding interest.

We also investigated whether motivation and skills in Grade 6 predicted parental profiles in Grade 9 (Table 5). Results of multinomial logistic regression indicated that, when the *Average support, high control* profile was used as the reference group, self-concept ($\beta = 0.43$, *S.E.* $= 0.13$, $p < 0.01$), task persistence ($\beta = 0.29$, *S.E.* $= 0.11$, $p < 0.01$), and math skills tended to be higher ($\beta = 0.26$, *S.E.* $= 0.10$, $p < 0.05$) in the *Average support and control* profile. Task persistence also tended to be higher in the *Low support, below average control* group compared to the *Average support, high control* profile group ($\beta = 0.44$, *S.E.* $= 0.17$, $p < 0.05$). There were no differences between the *Average support, high control* and *Low support, below average control* groups.

Third, we investigated how motivational factors and math skills predict profile transitions from Grade 6 to Grade 9. We used Grade 6 motivational factors and math scores to predict membership to the transition groups (Table 6). Multinomial logistic regression indicated that, when the *Combined group of low control and transition to low control* group was the reference, the *Stable high control* transition group tended to have lower self-concept ($\beta = -0.43$, *S.E.* $= 0.14$, $p < 0.01$), task persistence ($\beta = -0.37$, *S.E.* $= 0.11$, $p < 0.01$), and math skills ($\beta = -0.22$, *S.E.* $= 0.10$, $p < 0.05$). However, *Change to high control* transition group was quite similar to the *Stable high control* and the *Combined group of low control and transition to low control* group.

## Parental homework-help profiles and transitions as predictors of children's math skills (RQ2c)

We investigated whether Grade 6 parental profiles and transition profiles predict math skills in Grade 9 while controlling for Grade 6 math skills. First, we used Grade 6 parental profiles and math skills as predictors, and Grade 9 math skills as the dependent variable [$\chi^2(0) = 0.00$, $p = 0.00$; *CFI* $= 1.00$, *TLI* $= 1.00$, *RMSEA* $= 0.00$, *SRMR* $= 0.00$]. Results indicated that Grade 6 math skills predicted Grade 9 math skills ($\beta = 0.57$, *S.E.* $= 0.03$, $p = 0.00$). When the *Average support, high control* group was used as the reference group, belonging to the *Average support and control* group also predicted Grade 9 math

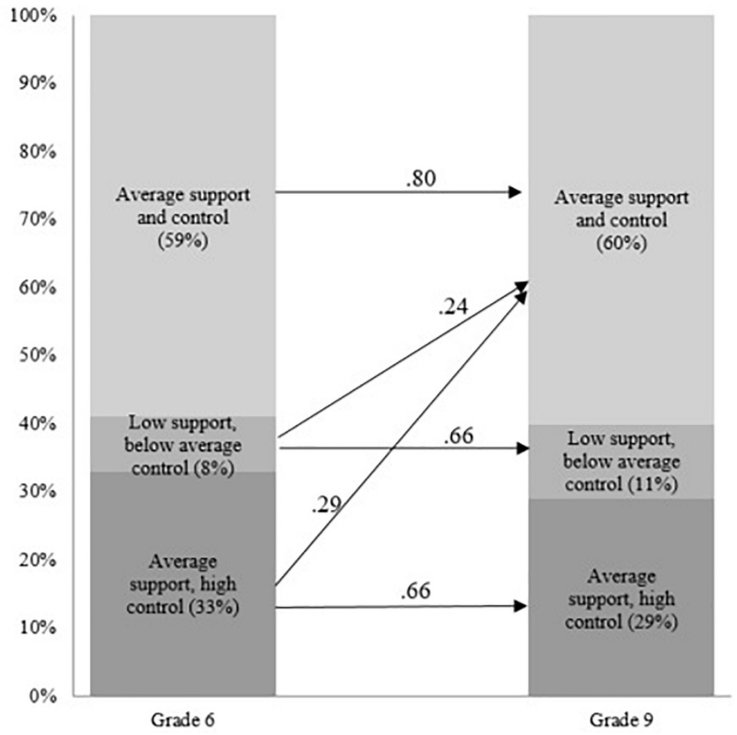


FIGURE 2
Latent transition probabilities between grades 6 and 9.

TABLE 4 Mean differences in grade 6 parental profiles regarding self-concept, interest, task persistence, and math skills.

| | Average support and control | Low support, below average control | Average support, high control | *F* | $\eta^2$ |
|---|---|---|---|---|---|
| | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | | |
| Self-concept | 3.55 (1.00)$^a$ | 3.21 (1.23) | 3.00 (0.95)$^a$ | 21.17* | 0.06 |
| Interest | 2.92 (1.19) | 2.72 (1.30) | 2.71 (1.16) | 2.45 | 0.01 |
| Task persistence | 3.69 (0.83)$^a$ | 3.78 (0.83)$^b$ | 3.32 (0.84)$^{ab}$ | 13.33* | 0.05 |
| Math skills | 8.59 (2.21)$^a$ | 8.26 (2.37) | 7.64 (2.25)$^a$ | 12.11* | 0.04 |

Mean scores that share the same superscript (a or b) are statistically significantly different. Due to unequal variances, Games-Howell post hoc test was used for self-concept; Bonferroni was used for all other indicators. *p < 0.01.

TABLE 5 Predictors of grade 9 parental homework-help profiles.

| | Average support and control[a] | | Low support, below average control[a] | | Low support, below average control[b] | |
|---|---|---|---|---|---|---|
| **Predictor** | $\beta$ **(S.E)** | **OR(S.E)** | $\beta$ **(S.E)** | **OR(S.E)** | $\beta$ **(S.E)** | **OR(S.E)** |
| Self-concept | 0.43 (0.13)* | 1.51 (0.19) | 0.04 (0.21) | 1.04 (0.21) | −0.39 (0.20) | 0.69 (0.13) |
| Interest | −0.18 (0.13) | 0.86 (0.09) | −0.28 (0.20) | 0.79 (0.13) | −0.10 (0.17) | 0.92 (0.13) |
| Task persistence | 0.29 (0.11)* | 1.40 (0.17) | 0.44 (0.17)* | 1.67 (0.33) | 0.15 (0.16) | 1.19 (0.22) |
| Math skills | 0.26 (0.10)* | 1.12 (0.05) | 0.11 (0.16) | 1.05 (0.07) | −0.15 (0.15) | 0.94 (0.06) |

[a] = Average support, high control profile was the reference group; [b] = Average support and control profile was the reference group. *p < 0.05.

skills ($\beta$ = 0.11, *S.E.* = 0.04, $p < 0.01$). There was no difference between the *Average support and control* and *Low support, below average control* profile groups.

Second, we used transition profiles and Grade 6 math skills as predictors, and Grade 9 math skills as the dependent variable [$\chi^2(0) = 0.00$, $p = 0.00$; *CFI* = 1.00, *TLI* = 1.00, *RMSEA* = 0.00, *SRMR* = 0.00]. Results indicated that Grade 6 math skills predicted Grade 9 math skills ($\beta$ = 0.57, *S.E.* = 0.03, $p = 0.00$). When the *Stable high control* transition group was used as the reference group, belonging to the *Combined group of low control*

TABLE 6 Predictors of transition groups from grade 6 to 9.

| | Combined group of low control and transition to low control[a] | | Stable high control[a] | | Stable high control[b] | |
|---|---|---|---|---|---|---|
| **Predictor** | **β (S.E)** | **OR(S.E)** | **β (S.E)** | **OR(S.E)** | **β (S.E)** | **OR(S.E)** |
| Self-concept | −0.05 (0.27) | 0.96 (0.24) | −0.48 (0.28) | 0.63 (0.17) | −0.43 (0.14)* | 0.66 (0.09) |
| Interest | −0.06 (0.29) | 0.95 (0.23) | 0.15 (0.31) | 1.14 (0.29) | 0.22 (0.14) | 1.20 (0.14) |
| Task persistence | −0.06 (0.21) | 0.93 (0.23) | −0.43 (0.21) | 0.60 (0.16) | −0.37 (0.11)* | 0.65 (0.08) |
| Math skills | 0.36 (0.20) | 1.17 (0.10) | 0.14 (0.21) | 1.07 (0.10) | −0.22 (0.10)* | 0.91 (0.04) |

[a] = Change to high control transition profile was the reference group; [b] = Combined group of low control and transition to low control was the reference group. *p < 0.05.

*and transition to low control* transition group also predicted Grade 9 math skills ($\beta = 0.12$, *S.E.* = 0.04, $p < 0.01$). There was no difference in math skills between the *Change to high control* transition group and the two other transition groups.

## Discussion

The current study used a person-oriented approach to investigate the relationship between parental help with math homework and students' math motivation and skills from Grades 6–9. These results expand on previous studies in four ways. First, we found evidence that children may perceive parental help as both supportive and controlling, and these perceived differences impact math learning and motivation. Second, there were no differences in parental profiles according to maternal education level; however, there were some differences according to child's gender in both grades. Third, students in distinct parental profile groups tended to have different levels of task persistence, self-concept, and math skills in Grade 6; as well, task persistence, self-concept, and math skills in Grade 6 were predictors of belonging into distinct parental profile groups in Grade 9. Fourth, profiles and transitions of child-perceived parental homework help predicted children's math skills in Grade 9.

### Parental homework-help profiles and transitions

Similar to earlier findings (Patall et al., 2008), we found that, although the average level of parental help with homework declined between Grades 6 and 9, the profiles of parental support and control remained quite stable. According to children's perceptions, parents engaged in both supportive and controlling help. The largest and most stable profile, *Average support and control*, included about 60% of children who perceived support a bit higher than control. This could be considered an adaptive profile, as advantages of support over control have been emphasized in earlier studies (Pomerantz et al., 2007).

During supportive help, parents take into account their child's needs and skill level, discussing problems that arise rather than only giving solutions. Thus, parents take into account their child's need for autonomy and competence (Ryan and Deci, 2020) and encourage both skill development and motivation (cf. Mermelshtine, 2017; Leith et al., 2018). In addition to support, children in this profile also perceived their parents to be controlling. Parents may occasionally initialize discussions about homework or check some tasks, or adolescents may be especially sensitive about parental interruptions and interpret questions about schoolwork as controlling.

In contrast, around one-third of students belonged to the non-adaptive *Average support and high control* profile. Students in this profile perceived considerable control, which may inhibit feelings of of competence in math, autonomy in homework completion, and relatedness with parents (Ryan and Deci, 2020). Higher levels of control may also undermine the positive effect of supportive help during homework completion.

The third profile (around 10% of children) consisted of students who reported very low support and below average control. This profile was unexpected, and such low scores may indicate that these parents help their children quite rarely. This profile may include children who seldom need or ask for help or children whose parents have insufficient ability to help in math, even when needed. It should be stressed that none of the profiles differed according to maternal education. Parents in this profile may perceive their children to be mature and independent enough to manage math homework on their own.

Between Grades 6 and 9, some students from the *Low support and below average control* and *Average support and high control profiles* moved to the *Average support and control* profile. Thus, according to children's perceptions, their parents became more involved, more supportive, and less controlling (cf. Cooper et al., 2000). Parents in these groups might respond to children's need for autonomy, but also to their increased reasoning level that allows discussions and negotiations (Hill and Tyson, 2009).

The finding that more boys belonged to non-adaptive profile groups in both grades confirms earlier findings that boys perceive higher parental control during homework completion (Dumont et al., 2012; Silinskas and Kikas, 2019a). By contrast, girls tended to remain in the same profile or change to a more adaptive profile in Grade 9. One explanation for this finding could be that girls tend to apply more effort and persistence in

completing homework tasks (for classroom behavior, see Kikas et al., 2020), thus do not elicit as much control from parents (see below). Adolescent girls are also more likely than boys to engage in academic help seeking (Schenke et al., 2015).

## Math motivation and skills predict parental math homework-help profiles and transitions

In Grade 6, children's task persistence, self-concept, and math skills were higher in the adaptive *Average support and control* profile as compared to the non-adaptive A*verage support, high control* profile. It may be argued that when parents are supportive and not overly controlling, they satisfy their children's basic needs, enhance their self-concept, and provide sufficient time for learning and completing tasks on their own (see the model by Trautwein et al., 2006). As a result, children also advance their math skills.

However, parents may also modify their approach, accounting for their children's skill and motivation levels (Pomerantz and Eaton, 2001; Silinskas and Kikas, 2019b). Support for this possibility was found when analyzing the effects of motivation and skills on Grade 9 profiles. Namely, as compared with the *Average support, high control* profile, belonging to the *Average support and control* profile was related to higher task persistence, self-concept, and math skills. These same factors also predicted belonging to the *Combined group of low control and transition to low control* as compared to the *Stable high control group*.

Parents can easily notice learning behavior during homework completion, and they parents may respond by either increasing or decreasing control or support. For instance, parents who see their child trying hard may take a step back. With this action, they support their child's autonomy in learning math. In contrast, a parent who sees their child leaving tasks unfinished and daydreaming may offer help. Although such help may be effective in the near term, it does not help a child become autonomous or confident in the long term (Ryan and Deci, 2020). These findings are consistent with earlier variable-oriented studies showing that low effort with homework (Dumont et al., 2014; Silinskas and Kikas, 2019b) and low math achievement (Silinskas et al., 2013; Dumont et al., 2014; Hoglund et al., 2015; Silinskas and Kikas, 2019a,b) elicit controlling behaviors from parents.

High math self-concept and high interest in math is observable *via* persistence and time spent on math learning (Trautwein et al., 2006; Dettmers et al., 2010; Katz et al., 2014; Eccles and Wigfield, 2020; Xu, 2020). If children are more confident in their math skills and have higher interest, they may also have positive attitudes toward supportive parental help; thus, parents may modify their behavior accordingly. We found only a positive effect of self-concept on parental behavior (cf. Silinskas and Kikas, 2019b for younger grades). Although supportive help has been found to enhance interest (Gottfried et al., 2009), interest did not differ among profiles in Grade 6 and did not predict transitions or profiles in Grade 9. It is worth noting that interest can be related to emotional reactions in younger children but cognitive dimensions in older children (Frenzel et al., 2012). Children with high interest in math may find other ways to enjoy math besides schoolwork (e.g., online courses), even if they consider ordinary schoolwork boring.

In addition, we found in Grade 6 that parents in the *Low support, below average control* profile reported their children to be more persistent when completing homework than parents in the *Average support, high control* profile. Similarly, high persistence in Grade 9 predicted belonging to the *Low support, below average control* profile as compared to the *Average support, high control* profile. Different explanations may be considered to justify the finding. From one side, parents may believe these children to be independent and therefore very rarely intrude in their studies. However, it is also possible that children of parents who offer little help must try hard by themselves. A low level of help may correspond to a parent's lack of math knowledge or insufficient teaching skills.

## Parental math homework profiles and transitions predict math skills in grade 9

In line with prior studies (Siegler et al., 2012; Geary et al., 2017), Grade 6 math skills predicted Grade 9 achievement. However, we found additional effects of Grade 6 profiles and transition groups. While we earlier justified the adaptiveness and non-adaptiveness of profiles theoretically, arguing that different levels of support and control may act as scaffolding for skills and motivation (Mermelshtine, 2017; Leith et al., 2018) to enhance or inhibit satisfaction of basic needs (Ryan and Deci, 2020), analyzes of the effects of profiles and transitions prove the adaptiveness empirically. Namely, as compared with the *Average support, high control* profile, the *Average support and control* profile had a positive effect on math skills in Grade 9. A similar effect was found for the *Combined group of low control and transition to low control* transition (the reference group was *stable high control*).

Thus, our results indicate that both supportive and controlling practices may be justified and useful when combined and integrated adequately. Too much control inhibits learning and achievement, while some level of control combined with a higher level of support enhances learning. While earlier studies have found to negative effects of control (Patall et al., 2008; Levpušček and Zupančič, 2009; Karbach et al., 2013; Silinskas et al., 2013; Dumont et al., 2014; Hoglund et al., 2015), person-oriented profile analyzes may explain why some studies did not find a positive effect of support for math achievement (Levpušček and Zupančič, 2009; Karbach et al., 2013; Silinskas and Kikas, 2019a).

### Limitations and practical conclusions

We did not take into account parents' own math skills and their teaching skills, which could impact if and how parents help their children. In addition, only child perceptions of parental help were investigated. Interest was assessed only *via* three questions about solving math tasks, while actual interest is expressed in variety of ways.

To interpret and generalize the findings, the specific cultural context of Estonia should be taken into account — namely, in both Grades 6 and 9, Estonian students have to complete national-level math tests for which they undergo intensive preparations. Estonian students may be given more homework than students in other countries, so Estonian parents may need to support their children's learning more.

In summary, person-oriented analyzes enrich our understanding of perceived parental help at the end of middle school by identifying different profiles and transitions of perceived parental help. These findings help conceptualize parental homework help as a multidimensional construct that is related to different prerequisites and consequences (Pomerantz et al., 2007; Patall et al., 2008; Dumont et al., 2012; Moroni et al., 2015). To enhance children's learning and achievement, parents should offer support that provides help, takes into account their child's current skills and motivation, encourages discussion about potential solutions, and enhances autonomy. Support may be accompanied by some controlling activities. However, perceiving control higher than support inhibits learning. We also found positive effects of children's task-persistent learning behavior, self-concept, and math skills on belonging to adaptive profiles and transitions.

Educators and professionals working with parents should emphasize the importance of children's perceptions on parental help. In addition, parents should be informed about the heterogeneity of perceived parental help (supportive versus controlling) and the fact that they manifest together, forming different patterns. Moreover, a combination of different aspects of perceived parental help relate to children's math skills and motivation — specifically, patterns of heightened perceived control may be less adaptive in terms of children's skills and motivation. In other words, if an adolescent perceives their parents' homework help as controlling, it may undermine their motivation to learn math. Unmotivated adolescents may not look for possibilities to practice math and thus miss opportunities to develop their skills. When giving specific advice about the way parents should support children with their homework, it is also important to draw parents' attention to their own reactions to children's motivation and math skills. As perceived control concerning math homework may lead to lower math performance, parents should be especially sensitive in helping low-achieving and unmotivated children. Help with math homework should be implemented in such a way that it diminishes the possibility of being perceived as controlling.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants or their legal guardian/next of kin.

## Author contributions

Material preparation, data collection and analysis were organized by EK who was the main researcher in the longitudinal "Kindergarten School Study". The draft of the theoretical part and discussion the manuscript was written by EK and commented by other authors. Statistical analyzes were carried out and reported by KM and GS. All authors contributed to the study conception and design, read, and approved the final manuscript.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# Appendix

## Appendix A

TABLE A1 Factor loadings (standardized estimates) of the confirmatory factor analyzes.

| Items | | Grade 6 | Grade 9 |
|---|---|---|---|
| **Perceived parental homework help during math homework** | | | |
| **Control** | | | |
| 1. | My parents help me with math homework even when I don't need any help | 0.63 | 0.61 |
| 2. | My parents often interfere when I'm doing math homework | 0.52 | 0.48 |
| 3. | When I'm doing math homework, my parents ask if I need help | 0.79 | 0.80 |
| 4. | My parents afford opportunity to do math homework together | 0.79 | 0.77 |
| **Support** | | | |
| 1. | My parents help me with math homework, if I ask them | 0.58 | 0.72 |
| 2. | When I'm doing math homework, I can ask my parents for help at any time | 0.85 | 0.89 |
| 3. | When I'm doing math homework, I can ask my parents for help if I do not understand something | 0.89 | 0.91 |
| 4. | My parents help me with math homework, if I'm having difficulties. | 0.60 | 0.68 |
| **Child outcomes** | | | |
| **Mother-rated task persistence during homework** | | | |
| 1. | If difficulty arises in doing assignments, does the child easily start doing something else? (reversed) | 0.81 | |
| 2. | Does the child actively try to manage even the difficult assignments? | 0.68 | |
| 3. | Does the child easily give up trying? (reversed) | 0.80 | |
| 4. | Does the child show activeness or endurance when doing the assignments? | 0.71 | |
| 5. | If the assignment does not go well, does the child begin to busy her/himself with this and that? (reversed) | 0.83 | |
| **Math self-concept** | | | |
| 1. | I do well in math, compared with my classmates | 0.82 | |
| 2. | I'm capable in math | 0.90 | |
| 3. | Math is difficult for me (reversed) | 0.69 | |
| 4 | I am good at math | 0.80 | |
| **Math-related interest** | | | |
| 1. | I like calculation and math tasks | 0.83 | |
| 2. | I like to solve calculation and math tasks at school | 0.94 | |
| 3. | I like to solve calculation and math tasks at home | 0.74 | |

TABLE A2 Model fit indices of the confirmatory factor analyzes.

| Model | $\chi^2$ | *df* | *p* | CFI | TLI | RMSEA | SRMR |
|---|---|---|---|---|---|---|---|
| Perceived parental homework help, Grade 6 | 118.560 | 18 | <0.001 | 0.947 | 0.918 | 0.095 | 0.057 |
| Perceived parental homework help, Grade 9 | 196.799 | 19 | <0.001 | 0.908 | 0.864 | 0.134 | 0.068 |
| Math self-concept, Grade 6 | 2.916 | 1 | >0.05 | 0.999 | 0.992 | 0.055 | 0.006 |
| Math-related interest, Grade 6 | 0 | 0 | <0.001 | 1.000 | 1.000 | 0.000 | 0.000 |
| Task persistence (mothers' ratings), Grade 6 | 8.704 | 4 | >0.05 | 0.997 | 0.992 | 0.045 | 0.009 |

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# Appendix B

TABLE B1 Psychometric properties of all study variables.

| | *n* | *M*/% | *SD* | Reliability (Cronbach's α) | Range | | Skewness |
|---|---|---|---|---|---|---|---|
| | | | | | Potential | Actual | |
| Support (Grade 6) | 623 | 3.45 | 0.65 | 0.82 | 1–4 | 1–4 | −1.51 |
| Support (Grade 9) | 518 | 3.18 | 0.80 | 0.88 | 1–4 | 1–4 | −1.05 |
| Control (Grade 6) | 623 | 2.00 | 0.80 | 0.80 | 1–4 | 1–4 | 0.48 |
| Control (Grade 9) | 516 | 1.56 | 0.63 | 0.77 | 1–4 | 1–4 | 1.14 |
| Math skill (Grade 6) | 652 | 8.25 | 2.28 | 0.84 | | 0–13 | −0.64 |
| Math skill (Grade 9) | 588 | 8.92 | 4.64 | 0.89 | | 0–19 | 0.17 |
| Self-concept in math (Grade 6) | 638 | 3.34 | 1.04 | 0.88 | 1–5 | 1–5 | −0.24 |
| Interest in math (Grade 6) | 637 | 2.84 | 1.19 | 0.88 | 1–5 | 1–5 | 0.13 |
| Task persistence (Grade 6) | 572 | 3.58 | 0.85 | 0.89 | 1–5 | 1–5 | −0.31 |
| Child gender (1 = boy, 2 = girl) | 719 | | | | | | |
| Boy | 378 | 52.6% | | | | | |
| Girl | 341 | 47.4% | | | | | |
| Mother's education | 568 | | | | | | |
| Low | 41 | 5.7% | | | | | |
| Medium | 323 | 44.9% | | | | | |
| High | 204 | 28.4% | | | | | |

TABLE B2 Correlations between study variables.

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Support (Grade 6) | | | | | | | | | | |
| 2 | Support (Grade 9) | 0.38** | | | | | | | | | |
| 3 | Control (Grade 6) | 0.27** | 0.22** | | | | | | | | |
| 4 | Control (Grade 9) | 0.10* | 0.26** | 0.46** | | | | | | | |
| 5 | Math skill (Grade 6) | −0.05 | 0.04 | −0.27** | −0.15** | | | | | | |
| 6 | Math skill (Grade 9) | −0.05 | 0.05 | −0.26** | −0.20** | 0.58** | | | | | |
| 7 | Self-concept in math (Grade 6) | 0.01 | 0.11* | −0.28** | −0.16** | 0.43** | 0.54** | | | | |
| 8 | Interest in math (Grade 6) | 0.03 | 0.09 | −0.08 | −0.04 | 0.18** | 0.20** | 0.63** | | | |
| 9 | Task persistence (Grade 6) | −0.02 | −0.05 | −0.25** | −0.23** | 0.20** | 0.30** | 0.28** | 0.18** | | |
| 10 | Child gender (1 = boy, 2 = girl) | 0.01 | −0.05 | −0.11** | −0.19** | 0.01 | −0.06 | −0.11** | −0.02 | 0.27** | |
| 11 | Mother's education | 0.04 | 0.07 | −0.04 | 0.03 | 0.09* | 0.11* | 0.02 | −0.01 | −0.01 | 0.01 |

* $p < 0.05$, ** $p < 0.01$.