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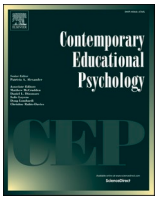

Trajectories of change in reading self-efficacy: A longitudinal analysis of self-efficacy and its sources

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ABSTRACT

The beliefs children hold about their capabilities as readers are known to influence their reading achievement. The aim of this study was to extend previous work by examining trajectories of change in reading self-efficacy among primary school students (N = 1327) and the relations between the trajectories of self-efficacy and their hypothesized sources over 11 months. Using growth mixture modeling, we identified four trajectories of change in reading self-efficacy, involving increasing, stable, and declining trends. These trajectories of change in reading self-efficacy were associated with students' varying experiences with the four sources of self-efficacy over time. Higher levels of mastery, verbal persuasion, and vicarious experiences and lower levels of physiological arousal were related to positive developmental trajectories of self-efficacy. Students with declining experiences of social sources of self-efficacy (i.e., verbal persuasions and vicarious experiences) had decreasing self-efficacy trajectories. These findings point to the importance of considering the variability in changes in reading self-efficacy and the interplay between changes in self-efficacy and sources of self-efficacy during primary school years, as well as the importance of monitoring these changes over time.

1. Introduction

Efficacy beliefs, which refer to beliefs about one's own capabilities to execute certain actions or tasks, have been found to be significant predictors of effort (Galla et al., 2014; Schnell, Ringeisen, Raufelder, & Rohrmann, 2015) and achievement (Multon, Brown, & Lent, 1991; Talsma, Schüz, Schwarzer, & Norris, 2018). Researchers have shown that, in the context of reading, efficacy beliefs are important predictors of reading-related behaviors (e.g., Hornstra, van der Veen, & Peetsma, 2016; Smith, Smith, Gilmore, & Jameson, 2012). However, less is known about how efficacy beliefs in reading develop and change, particularly in the primary school years.

It is theorized that efficacy beliefs are formed by how people perceive and interpret information from four main sources: mastery experiences, verbal and social persuasions, vicarious experiences, and physiological and emotional states (Bandura, 1997). However, previous studies have primarily investigated the relationship between these sources and self-efficacy cross-sectionally (e.g., Joët, Usher, & Bressoux, 2011; Usher & Pajares, 2006). Little is known about how the hypothesized sources of self-efficacy and changes in students' exposure to these sources of information over time relate to longitudinal changes in self-efficacy. In addition, longitudinal self-efficacy research has taken a variable-centered approach (e.g., Hornstra, van der Veen, Peetsma, & Volman, 2013; Phan, 2012a). However, this approach does not account for the possibility that the direction of self-efficacy development likely varies significantly among children, as shown in person-centered research on children's self-concepts (Archambault, Eccles, & Vida, 2010). For some children, reading self-efficacy might increase; for others, it might decrease. The rate of change in self-efficacy likely varies too. These varying longitudinal changes in children's self-efficacy may be based on their varying exposure to efficacy-building experiences (i.e., sources of self-efficacy; see Chen & Usher, 2013).

In the present study, we address these gaps using both variable- and person-centered approaches (see Howard & Hoffman, 2018; Woo, Jebb, Tay, & Parrigon, 2018) to investigate the interplay between changes in reading self-efficacy and the hypothesized sources of reading self-

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efficacy among primary school children. A better understanding of these changes and their relations could help researchers to develop efficient means of support to promote positive development in children's efficacy beliefs in primary school.

1.1. Changes in self-efficacy

Efficacy beliefs are theorized to change more easily than more general motivational beliefs (e.g., self-concept; Bong & Skaalvik, 2003). However, the examination of how self-efficacy changes over time, especially during the primary school years, has been scant in the literature. The few previous studies pertaining to self-efficacy development among primary school children have focused on different research questions, methodological approaches, and time frames to investigate such changes. Studies exploring mean-level changes in self-efficacy found that children report increasing confidence in their capabilities over time (e.g., Hornstra et al., 2016; Phan, 2012a, 2012b), although the patterns of these changes differ. Some researchers reported that self-efficacy increased linearly across Grades 5–6 (Hornstra et al., 2016). Others found a nonlinear pattern of change in self-efficacy among students of Grades 3–6 across one school year (2012b; Phan, 2012a), whereas one study observed that self-efficacy first declined and then increased across Grades 3–6 (Hornstra et al., 2013).

Other researchers have assessed changes in the relative ordering of children's self-efficacy levels (i.e., rank-order stability) and have reported somewhat inconsistent results. On the one hand, Phan and Ngu (2016) found that the rank-order of Grade 6 students' level of math self-efficacy hardly changed over one year (stability coefficients = 0.64–0.79). On the other hand, Phan, Ngu, and Alrashidi (2018) found the rank-order of math self-efficacy to be fairly unstable (stability coefficients = 0.23–0.44) for Grade 7 students over the course of 9 months. These results indicate individual variability in the rate of change. Other researchers provided evidence that self-efficacy is less stable among younger (e.g., elementary-age) students than their older counterparts (i.e., secondary students), at least for math (Davis-Kean et al., 2008; see Talsma et al., 2018).

Most studies examining changes in self-efficacy over time focused on the average trend or variability in change in self-efficacy for the full sample. However, the previous findings suggest that changes in self-efficacy may not be similar for all children. Studies consistently show that children differ in the absolute level of self-efficacy (e.g., Butz & Usher, 2015) and that changes in their self-efficacy are positive over time (e.g., Hornstra et al., 2016; Schöber, Schütte, Köller, McElvany, & Gebauer, 2018). However, conflicting findings regarding the rate of change in self-efficacy (Phan & Ngu, 2016; Phan et al., 2018) and its shape (2012b; Hornstra et al., 2016; Phan, 2012a) suggest that children may also differ with regard to these aspects. In addition, the rate of change was found to differ slightly as a function of the observed characteristics of the individuals, such as gender (Hornstra et al., 2013). However, we are not aware of any previous studies examining this possible heterogeneity in the level, direction, and rate of change in self-efficacy simultaneously. Using a person-centered approach (see Bergman & Trost, 2006; Gillet et al., 2019; Howard & Hoffman, 2018; Woo et al., 2018), one can identify subgroups of children who may exhibit differential levels of self-efficacy and/or differential rates and directions in their self-efficacy development over time. Studying this heterogeneity could help to clarify the inconsistencies in the empirical research findings and enrich researchers' understanding of changes in children's self-efficacy. Moreover, it could help identify groups of children who may be more vulnerable than others to decreasing self-efficacy over time.

In this study, we examine changes in self-efficacy in the less studied context of reading—specifically in the context of reading fluency. The development of reading fluency (i.e., sufficient automaticity and speed of reading; LaBerge & Samuels, 1974) is a hallmark of primary school education and is required for children to make the shift from learning-to-read to reading-to-learn. Developmental changes in reading self-efficacy, to our knowledge, have only been examined by Schöber et al. (2018), who investigated changes across one school year among Grade 7 students. At the mean level, reading self-efficacy was found to increase across the school year, whereas the rank order of students' self-efficacy remained relatively stable.

Prior studies have not addressed changes in reading self-efficacy among primary school children, although this period can be assumed to be especially important for the development of self-referent beliefs (e.g., Harter, 2012). Indeed, changes in self-efficacy might be more likely to occur during the primary than the secondary school years (see Davis-Kean et al., 2008), particularly in reading, a domain in which learners' skills change and develop more rapidly during childhood. Moreover, efficacy beliefs developed in the primary years set the foundation for how reading skills develop as early as Grade 2 (e.g., Peura et al., 2019b; Peura et al., 2019a).

1.2. Reading skills and changes in self-efficacy

In social cognitive theory, efficacy beliefs are considered to be predictors of future behaviors (i.e., skills and performance; Bandura, 1986). In addition, the interpretations people make of their past performances are assumed to influence their efficacy beliefs. That is, efficacy beliefs and performance accomplishments are considered to affect each other reciprocally (see Talsma et al., 2018). Stronger skills and better performance enhance one's perceived capability, which in turn begets higher effort, engagement, and skill development.

Findings from cross-sectional studies support the positive relation between reading self-efficacy and reading fluency skills (e.g., Peura et al., 2019a; Carroll and Fox, 2017). In addition, students' initial level of reading performance has been found to positively predict their subsequent level of reading self-efficacy (Schöber et al., 2018) as well as changes in their self-efficacy (Hornstra et al., 2013). However, researchers have not yet examined how children's reading skills relate to different trajectories of change in reading self-efficacy over time. Presumably, children with stronger reading skills end up on a positive developmental path, whereby their successes raise their efficacy beliefs. Conversely, the efficacy beliefs of children with weaker reading skills might develop more slowly.

1.3. Sources of self-efficacy predicting changes in self-efficacy

A substantial body of cross-sectional research has shown that four hypothesized sources of self-efficacy affect learners' academic efficacy beliefs even though their roles may vary (see, e.g., Sheu et al., 2018; Usher & Pajares, 2008). The manner in which people interpret their past experiences (*mastery experience*) is the most powerful source of self-efficacy (see, e.g., Byars-Winston, Diestelmann, Savoy, & Hoyt, 2017; Usher & Pajares, 2008). Experiences of success increase self-efficacy for similar tasks. In addition, *verbal and social persuasions* received from others, such as teachers, parents, and peers, can raise or undermine self-efficacy. Positive feedback and encouragement from others can help students increase their confidence in their capabilities. Verbal persuasions have been found to increase early adolescents' confidence in reading to a greater extent than in math (Butz & Usher, 2015).

Observing how others perform (*vicarious experience*), especially those perceived as similar to oneself, also informs beliefs about one's own capabilities. Seeing a peer succeed may boost observers' confidence that they too might succeed in a similar challenge. Although peers' success is thought to build efficacy beliefs, empirically, the association has either been fairly weak or has not been found (see, e.g., Byars-Winston et al., 2017). This may partly relate to problems in operationalizing vicarious experiences (Usher & Weidner, 2018). The influence of social models on learners' self-efficacy may depend on learners' developmental stages or on the characteristics of the social model (e.g., whether the person is a peer, teacher, or parent; Ahn, Bong, & Kim, 2017). The fourth source of self-efficacy concerns how people feel and interpret their *physiological*

and emotional states (such as anxiety) when engaging in activities. For example, if feelings of stress and anxiety are interpreted as a lack of capability, self-efficacy is undermined. Emotional arousal has been found to be especially predictive of students' self-efficacy in math (e.g., Phan, 2012b; Usher & Pajares, 2009; Usher, Ford, Li, & Weidner, 2019).

Although the sources of self-efficacy are theoretized to predict self-efficacy development, only a few studies have empirically examined this longitudinally. Phan, 2012a, 2012b) found varying patterns in the associations between the sources of self-efficacy and changes in primary school students' self-efficacy. Among students in Grades 3–4, only mastery experiences were positively related to changes in English self-efficacy. Contradictory findings were observed in mathematics, where mastery experiences and emotional states were negatively related to changes in self-efficacy (Phan, 2012a). However, among students in Grade 5–6, verbal persuasions and emotional statespositively and negatively predicted, respectively, changes in mathematics self-efficacy, while mastery and verbal experiences were positively and negatively related to changes in science self-efficacy, respectively (Phan, 2012b). Phan (2012a) concluded that self-efficacy development is complex and nonsystematic. To complicate the picture, these findings differed from the cross-sectional relations between self-efficacy and its sources reported in previous studies (see, e.g., Byars-Winston et al., 2017).

Several factors may explain these inconsistent previous findings. First, previous studies have primarily focused on the average associations between each source of self-efficacy and self-efficacy development for the full sample (e.g., Phan, 2012a, 2012b), thereby overlooking possible individual variations in the associations between these variables. As students have been found to differ with regard to how strongly they rely on each source of self-efficacy when judging what they can do (see Chen & Usher, 2013), accounting for individual variability might reveal different results.

Second, it is also possible that the relationships between self-efficacy and its sources vary according to the particular skills being developed. Indeed, previous cross-sectional research has shown skill-specific variability in the sources of self-efficacy (e.g., Byars-Winston et al., 2017; Phan, 2012a; Usher et al., 2019). For instance, Butz and Usher (2015) found that half of the early adolescents in their study reported different sources of self-efficacy in reading and mathematics. A recent meta-analysis revealed that the four sources of self-efficacy predicted self-efficacy less in science, technology, engineering, and mathematics (STEM) domains than in non-STEM domains (Byars-Winston et al., 2017). In the few studies that have focused specifically on reading, students have reported that feedback from teachers and parents, as well as mastery experiences, influence their self-efficacy (Butz & Usher, 2015; Guthrie et al., 2007; Henk & Melnick, 1998).

We are aware of only one study that has investigated changes in the sources of students' self-efficacy over time. Phan and Ngu (2016) found that the rank order of Grade 6 students' efficacy-relevant experiences in math changed to a greater extent over one school year (rank-order stabilities = 0.19–0.44) than their math self-efficacy (rank-order stabilities = 0.64–0.79). Cross-sectional associations indicated that mastery experiences were related to math self-efficacy at every time point assessed, whereas the relationship between other sources and self-efficacy varied between time points. However, the reciprocal associations between the sources and self-efficacy were not examined over time, nor was the interplay between the changes in these sources and self-efficacy.

1.4. Aims of this study

In the present study, we seek to understand the dynamics of change in reading self-efficacy and its hypothesized sources (i.e., mastery experiences, verbal persuasions, vicarious experiences, and physiological and emotional states). In doing so, we hope to expand on previous research by examining varying trajectories of change in reading self-efficacy (i.e., differences in the level, direction, and rate of change in self-efficacy) and the interplay between the changes in self-efficacy and its sources over time. Furthermore, we focus on the less studied contexts of primary school students and their reading fluency skills.

The following research questions are examined:

(1) *How does reading self-efficacy change over time among students in Grades 2–5?*

We expect to find positive changes in reading self-efficacy over time (Hypothesis 1 (H1)) in line with findings showing increasing self-efficacy among primary (e.g., Hornstra et al., 2016; Phan, 2012a, 2012b) and secondary (Schöber et al., 2018) school students.

(2) *Are there heterogeneous trajectories of change in reading self-efficacy?*

We assume that children's trajectories of change in reading self-efficacy would be heterogenous in terms of level, direction, and rate of change (Hypothesis 2 (H2)), as previous studies have shown general variability in the development of self-efficacy among primary school students (Hornstra et al., 2013), and the findings regarding the rate (Phan & Ngu, 2016; Phan et al., 2018) and shape (Hornstra et al., 2013, 2016) of change have been inconsistent. However, we cannot present corresponding person-centered empirical evidence on which to base more explicit hypotheses concerning the possible initial self-efficacy levels, number, or directionalities of students' self-efficacy trajectories.

(3) *Are reading skills related to different trajectories of change in reading self-efficacy?*

As students' initial level of reading achievement have been found to positively predict self-efficacy development among primary school students (Hornstra et al., 2013) and the subsequent level of self-efficacy among Grade 7 students (Schöber et al., 2018), we hypothesize that higher levels of reading skills would be linked to trajectories with higher initial levels of self-efficacy and positively developing self-efficacy trajectories (Hypothesis 3 (H3)).

(4) *Are the levels of and changes in the sources of reading self-efficacy related to different trajectories of change in reading self-efficacy?*

As high levels of positive efficacy-building experiences have been found to be related to higher levels of self-efficacy (see Byars-Winston et al., 2017), we assume that higher levels of positive efficacy-relevant experiences (e.g., mastery experience, social persuasion, and vicarious experience) and lower levels of negative efficacy-relevant experiences

(adverse physiological and affective states) would be associated with positively developing self-efficacy trajectories (Hypothesis 4 (H4)). Correspondingly, we expect lower levels of positive sources of self-efficacy and higher levels of adverse physiological and affective states to be related to decreasing trajectories of self-efficacy (Hypothesis 5 (H5)). However, as the findings of the few previous longitudinal studies are inconsistent, we did not form more specific hypotheses.

2. Method

2.1. Participants and procedure

The participants of this study comprised 1327 children in Grades 2–5 (range = 7.84–12.83 years; $M = 9.97$, $SD = 1.05$) from 20 primary schools in Finland. This study is part of a longitudinal investigation that focuses on children's self-beliefs as well as reading and math development. Volunteering teachers were recruited for the project via municipality officials responsible for basic education. A total of 20 primary schools and 75 classes from rural, suburban, and urban areas participated.[1] The students participated voluntarily with the written informed consent of their legal guardians. The Ethical Committee of the first author's university evaluated the research procedure. Children's reading self-efficacy and sources of reading self-efficacy were assessed with questionnaires. Trained research assistants supervised the assessment. To ensure that all children could answer the questions irrespective of their reading skill, all the questionnaire items were read aloud. In addition, practice items were used to familiarize the children with the applied response scale. Survey administrations took place over three time points across two school years [Year 1: November (T1) and May (T2); Year 2: September (T3)]. Between T1 and T2, 2.7% of the children, who were among the lowest-achieving group of children in reading, participated in a reading fluency and self-efficacy intervention (for details of the intervention, see Aro et al., 2018). The effect of the intervention was controlled for in all the analyses.

2.2. Measures

Reading self-efficacy was measured with three items assessing children's confidence in mastering everyday reading tasks (e.g., *How confident you are that you can read a long book?*). These items were part of the scale created for measuring reading self-efficacy in primary school children. Bandura (2006) recommendations for measuring self-efficacy were followed when constructing the scale. The children responded on a seven-point scale varying from *I'm totally certain I can't* to *I'm totally certain I can* (α = 0.67–0.70; see Peura et al. (2019a) for details on the psychometric properties of the scale; the sample used in the cited work was the same as that in the present study). We elected to measure efficacy beliefs related to everyday reading practices in the present study, because they have been found to be the most predictive of reading fluency and its development (Peura et al., 2019b; Peura et al., 2019a).

Reading skills were assessed in terms of the children's word-, sentence-, and text-level reading speeds and accuracies in T1. The tests were time-limited: two of them were administered in groups (i.e., the word chain test, Lindeman, 1998; the sentence verification task, Eklund, Salmi, Polet, & Aro, 2013) and one was administered individually (i.e., the text reading task, Salmi, Eklund, Järvisalo, & Aro, 2011).

The *word chain test* (*word reading*) consisted of words written in clusters of 2–4 words with no spaces between them (adding up to 78 word chains altogether). The task was to silently read and separate the words with a vertical line as fast as possible. The test score was the number of words correctly identified within 3.5 min. This test is standardized and has been shown to have high scale reliability (α = 0.97, standardization sample, Lindeman, 1998).

The *sentence verification task* (*sentence reading*), similar to the Woodcock–Johnson Reading Fluency task (Woodcock, McGrew, & Mather, 2001), consisted of 70 semantically simple and short statements. After silently reading each statement, a child was asked to mark whether the statement was correct or incorrect. The test score was the number of correct responses made within 2 min. This test is standardized and has been shown to have high scale reliability (α = 0.94, split-half α = 0.97, standardization sample; Eklund et al., 2013).

In the *text reading* task, the children read an age-appropriate text for 90s and were instructed to read as accurately and as quickly as they could. A text reading score was calculated as the number of words read correctly within the time limit. Performance across different text versions has been shown to correlate highly ($r = 0.93$–0.97; Salmi et al., 2011). Performance in the text reading task correlated satisfactory with the word ($r = 0.64$) and sentence ($r = 0.69$) reading tasks. A sum score of the reading tests was used in the analysis, as previous examination showed that these tests satisfactorily measure the same construct, namely reading fluency (Peura et al., 2019a). The reading test scores were standardized within each grade level prior to analyzing the full sample.

The *sources of reading self-efficacy* were assessed using 13 items adapted for the reading context from a questionnaire previously validated in math (Usher & Pajares, 2009). The four-factor structure representing the sources of self-efficacy (i.e., mastery experiences, verbal persuasions, vicarious experiences, and physiological and emotional states) fit the data well ($\chi^2(58) = 144.39$, $p < .001$; root mean square error of approximation (RMSEA) = 0.03; comparative fit index (CFI) = 0.98; Tucker–Lewis (TLI) = 0.98; standardized root mean square residual (SRMR) = 0.03). The four-factor structure is presented in Appendix A. The invariances of the sources of the self-efficacy model were examined using multi-group invariance comparison tests by grade level, which are presented in Appendix B. The invariance comparisons indicated strong measurement invariance (Meredith, 1993) across grade levels. The children rated their mastery experiences (three items, e.g., *I have always been successful with reading*, α = 0.80–0.84), verbal persuasions (four items, e.g., *I have been praised for my reading skills*, α = 0.83–0.87), vicarious experiences (three items, e.g., *I admire adults who are good readers*, α = 0.77–0.81), and physiological and emotional states (three items, e.g., *I feel tension in my body when I have to read*, α = 0.80–0.85) using a seven-point Likert scale (1 indicating *not true* to 7 indicating *true*). The original items are presented in Appendix C. Higher scores for mastery experiences, verbal persuasions, and vicarious experiences referred to positive experiences, whereas higher scores on the physiological and emotional state subscales represented experiences of more adverse physiological arousal and emotional states.

[1] Sample selection procedure: The special education teachers in four municipalities in central and eastern Finland were given information about participation in this research project after the authors received permission from the municipality officials responsible for comprehensive schools. All interested special education teachers working in Grades 2–5 and teaching mainstream students were invited to join the study. The participating schools were located in rural, suburban, and urban areas. The study included small as well as big schools.Demographic information (pertaining to socioeconomic differences) in Finland: Finland continues to be a rather homogenous society in that socioeconomic and demographic differences are small compared to those observed for many other countries (see PISA 2015, http://www.oecd.org/pisa). Ninety-five percent of the population of each city that contributed to this study's sample is Finnish-speaking, and the number of immigrants in each of them is low (no more than 3.2% of the cities population). In addition, Finnish schools are relatively homogeneous: 96% of the schools are publicly maintained (Official Statistics of Finland, 2017), and children attend the public school nearest to their home. In addition, the socioeconomic variations between schools are slight (e.g., OECD, 2013). Given the provision of free public education up to the university level, socioeconomic background variables tend to play less of a role in Finland than many other countries.

2.3. Statistical analyses

All the analyses were performed using the MPlus software, version 8.0 (Muthén & Muthén, 1998, 2017) with the robust maximum likelihood estimator. The data set included 3.3–5.1% missing values at T1, 6.6–7.5% missing values at T2, and 10.9–14.5% missing values at T3. Little (1988) missing completely at random test showed that the data were not missing completely at random ($\chi^2(25062) = 28767.41$, $p < .001$). However, the data were considered to be missing at random, as the reasons for the missing values were tracked to students who moved to another school during the study, students' absence from school on the day of data collection, or single skipped items. Furthermore, the missing values were not found to be related to the students' initial level of self-efficacy. The full information maximum likelihood procedure, which uses all the information in the data without imputing missing values, was used to handle missing data in all the analyses (Enders, 2010). The students were nested within 20 schools and 75 classes. To examine the proportion of the variance in self-efficacy due to school and class, intraclass correlations (ICCs) were calculated. The ICCs by school were small (0.01–0.04) and nonsignificant. The ICCs by class were small (0.05–0.09) and significant; however, when the grade level was controlled for, no significant class-related variation in self-efficacy was observed. To consider the hierarchical nature of the data by class, we used the TYPE = COMPLEX option in MPlus to estimate unbiased standard errors.

Changes in reading self-efficacy over three time points (Research Question 1) were examined with latent growth curve modeling (LGM; Muthén & Khoo, 1998). Linear and nonlinear shapes of change were explored to find the best fitting model. Gender, grade level, and intervention status were included as covariates in the self-efficacy model by allowing them to influence latent growth factors (i.e., intercept and slope).

The overall goodness-of-fit of the estimated LGMs was evaluated with the χ^2 test. However, as the χ^2 test is sensitive to a large sample size, and given the non-normality of the data, we also considered the CFI (Bentler, 1990), TLI (Tucker & Lewis, 1973), RMSEA (Steiger, 1990) with a 90% confidence interval, and SRMR (Hu & Bentler, 1995). Values higher than 0.95 for both the TLI and the CFI and smaller than 0.06 for RMSEA and 0.08 for the SRMR were considered representative of a well-fitting model to the data (Hu & Bentler, 1999).

The trajectories of change in reading self-efficacy were identified using growth mixture modeling (GMM; Muthén, 2004; Research Question 2). Our work followed the guidelines provided by van de Schoot, Sijbrandij, Winter, Depaoli, and Vermunt (2017) for reporting on latent trajectory studies. Means of the initial level and slope of reading self-efficacy were allowed to vary across trajectories. GMM classifies each individual in these trajectories in a probabilistic manner. We estimated various GMM solutions for up to seven trajectories. The appropriate number of trajectories was selected based on the goodness of fit of the estimated models, classification quality of the solution, and interpretability of the solution (following the guidelines noted in Marsh, Ludtke, Trautwein, and Morin (2009) and Morin et al. (2011)). Given our large sample size ($N = 1327$), very small data-specific trajectories without practical significance and that were unlikely to be replicated could have emerged. Therefore, the trajectory solutions that resulted in the extraction of at any trajectory that included<1% of all students were not considered. The goodness of fit values of the GMMs were evaluated according to the following criteria: log likelihood ratio (LLR); Bayesian information criterion (BIC; Schwartz, 1978), sample size-adjusted BIC (aBIC; Yang, 2006), and the Lo–Mendell–Rubin (LMR; Lo, Mendell, & Rubin, 2001) and Vuong–Lo–Mendell–Rubin (VLMR; Lo et al., 2001) likelihood ratio (LR) tests. Lower values of the LLR and information criteria (BIC and aBIC) indicate better model fits. For LRM and VLMR, a significant p value provided by the test indicates a better fitting model than that with one class less. Further, we evaluated the classification quality by examining the Entropy index and average latent class probabilities, in which values close to 1 indicate a distinct classification (Celeux & Soromenho, 1996). An average latent class probability of greater than 0.7 for all groups is recommended (Nagin, 2005).

Next, the associations between the initial reading skill levels and self-efficacy trajectories were examined (Research Question 3) using the Bolck–Croon–Hagenaars (BCH) approach (Asparouhov & Muthén, 2018; Bakk & Vermunt, 2014) implemented in Mplus. The BCH procedure estimates a weighted multiple group analysis to examine the differences between the self-efficacy trajectories as a function of students' initial reading levels. The measurement error related to the classification of students into the self-efficacy trajectories was considered using weights that are inversely related to the classification error probabilities obtained from the GMM (Bakk, Tekle, & Vermunt, 2013). We used the automatic BCH method (Asparouhov & Muthén, 2018).

The overall differences in the level of reading between the self-efficacy trajectories were examined using LLR tests (Satorra & Bentler, 2010). Wald tests were used to examine pairwise comparisons between the trajectories. Cohen's d was used as a measure of the effect size of the mean differences between the trajectories (Cohen, 1988). Effect sizes ranging from 0.10 to 0.30 are considered as small effects, 0.30 to 0.50, as intermediate effects, and 0.50 and higher, as strong effects (Cohen, 1988).

Finally, the association of the self-efficacy trajectories with the levels of and changes in the sources of self-efficacy (i.e., mastery experiences, verbal persuasions, vicarious experiences, and physiological and emotional states) were examined (Research Question 4). First, LGMs (Muthén & Khoo, 1998) were built to investigate the changes in each source of self-efficacy over the three time points. Similar to the procedure followed to construct LGMs of self-efficacy, both linear and nonlinear shapes of the changes were explored to find the best fitting model. Gender, grade level, and intervention status were included as covariates in all sources of self-efficacy LGMs by allowing them to influence latent growth factors (i.e., intercept and slope). The BCH approach was used to examine the associations between the self-efficacy trajectories and the LGMs of the sources of self-efficacy. We used the manual BCH method (Asparouhov & Muthén, 2018) instead of the automatic version for two reasons. First, our predictor variables were latent variables (i.e., four sources of self-efficacy) produced by the LGMs. Second, we wanted to control for gender, age, and intervention status in the analyses. In addition, reading skill level at T1 was controlled for. It is not possible to include latent predictors in the automatic version of the BCH method. Moreover, multiple control variables cannot be considered simultaneously. The overall differences in the means of the level and changes in the sources of self-efficacy between the self-efficacy trajectories were examined using likelihood ratio tests. Wald tests were used to examine pairwise comparisons between the trajectories. Cohen's d was considered as a measure of the effect size of the mean differences between the trajectories (Cohen, 1988).

3. Results

The means, standard deviations, and bivariate correlations for all the study variables are presented in Table 1.

3.1. Changes in reading self-efficacy over time: variable-centered approach

To address our first research question, we investigated changes in reading self-efficacy using LGMs. The model including the initial level and linear slope fit the data the best (see the first row of Table 2 for estimates and fit statistics of the reading self-efficacy model). The variance of the *level* of reading self-efficacy suggested that students differed in their initial levels of reading self-efficacy. The positive mean of the *slope* indicated that students' average reading self-efficacy levels increased over the study period as hypothesized (H1). However, differences were noted between the students in terms of the rate of change:

Table 1
Means (M), Standard Deviations (SD) and correlations between the study variables.

	Mean	*SD*	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1. Reading self-efficacy T1	5.87	1.15	–														
2. Reading self-efficacy T2	5.92	1.12	0.59	–													
3. Reading self-efficacy T3	6.06	1.04	0.53	0.61	–												
4. Mastery experience T1	5.72	1.23	0.47	0.40	0.35	–											
5. Mastery experience T2	5.72	1.21	0.41	0.48	0.42	0.62	–										
6. Mastery experience T3	5.69	1.27	0.38	0.44	0.44	0.53	0.67	–									
7. Verbal persuasion T1	4.85	1.60	0.16	0.14	0.16	0.38	0.29	0.24	–								
8. Verbal persuasion T2	4.50	1.75	0.12	0.16	0.23	0.25	0.34	0.30	0.57	–							
9. Verbal persuasion T3	4.49	1.79	0.10	0.13	0.21	0.20	0.27	0.35	0.50	0.67	–						
10. Vicarious experience T1	4.75	1.74	.03[a]	.02[a]	.05[a]	0.20	0.11	0.13	0.56	0.38	0.31	–					
11. Vicarious experience T2	4.19	1.93	.00[a]	0.07	0.11	0.12	0.19	0.18	0.39	0.56	0.46	0.56	–				
12. Vicarious experience T3	4.18	1.88	−.04[a]	0.06	0.12	0.09	0.13	0.24	0.34	0.47	0.55	0.49	0.70	–			
13. Physiological and emotional states T1	2.00	1.44	−0.29	−0.20	−0.23	−0.26	−0.22	−0.23	.02[a]	−.01[a]	−.03[a]	0.12	0.09	0.09	–		
14. Physiological and emotional states T2	1.74	1.30	−0.26	−0.26	−0.21	−0.23	−0.29	−0.25	−0.09	−.04[a]	−.05[a]	−.01[a]	0.08	0.06	0.43	–	
15. Physiological and emotional states T3	1.75	1.32	−0.24	−0.20	−0.19	−0.23	−0.31	−0.30	−.05[a]	−.06[a]	−.01[a]	.00[a]	0.08	0.09	0.42	0.60	–
16. Reading level T1[b]	76.41	27.30	0.37	0.39	−0.07	0.77	.22[a]	0.60	.16[a]	.21[a]	.04[a]	−0.38	−0.43	−.21[a]	−0.48	−.04[a]	.11[a]

Note. $N = 1327$. All correlations statistically significant at $p < .05$, except non-significant correlations marked with [a].
[b]Reading scores standardized within grade level.

self-efficacy increased more sharply for some students than for others. The covariance between the level and slope of self-efficacy was small but negative, indicating that the higher the self-efficacy at the beginning of the study, the slower the rate of improvement in reading self-efficacy over time.

3.2. Changes in reading self-efficacy over time: person-centered trajectories

To answer the second research question, we examined the different trajectory patterns in reading self-efficacy by estimating various GMM solutions reflecting up to seven trajectories (see Table 3 for the fit statistics of the different trajectory solutions). None of the estimated GMM solutions received consistent support from the fit indices and information criteria. The information criteria (BIC and aBIC) continued to decrease as the number of trajectories increased. However, the decrease decelerated slightly in the aBIC after the four-trajectory solution and in the BIC after the three-trajectory solution. Both the LMR and VLMR tests favored a four-trajectory solution over its three-trajectory counterpart ($p < .05$). Moreover, in models with more than four trajectories, the number of students in some trajectories became very small (i.e., including <1% of all the students). Furthermore, the additional trajectories did not reveal any new patterns of growth; they differed only slightly by the level of self-efficacy. Entropy was high in all solutions. Average latent class probabilities were high (greater than 0.82) in the four-trajectory solution. Based on these findings, we chose to proceed with the four-trajectory solution.

The results for the four distinct trajectories of change in the children's reading self-efficacy (i.e., means of the level and slope of self-efficacy by self-efficacy trajectory) are presented in Table 4. The trajectories are graphically illustrated in Fig. 1. Most (75.8%) of the children belonged to the trajectory labeled as "High Increasing." The children in this group had high self-efficacy at the beginning of the follow-up, which improved slightly thereafter. In the second trajectory, labeled as "Average Stable" (11.5%), the children reported rather high self-efficacy at the beginning of the study (although this value was lower compared to that of the children in the "High Increasing" trajectory), and their self-efficacy did not change significantly over the study period. The two other trajectories were labeled as "Low Increasing" (8.8%) and "Low Decreasing" (3.6%). Both these trajectories were characterized by relatively low self-efficacy at the beginning of the study. Whereas students in the "Low Increasing" trajectory reflected improvement in their self-efficacy throughout the study, those in the "Low Decreasing" trajectory showed decreasing levels of reading self-efficacy. Our hypothesis that the trajectories of change would be heterogenous was thus confirmed (H2).

3.3. Initial level of reading skills in relation to reading self-efficacy trajectories

Our third research question examined whether the children's initial reading level were related to their reading self-efficacy trajectory. The estimated mean reading skill level by each self-efficacy trajectory are reported in Table 5. The LR test revealed significant differences in the reading skill level of the children in each of the four self-efficacy trajectories. Pairwise comparisons between the trajectories (see Table 5) indicated that the children in the "High Increasing" trajectory had better reading skills than those in the other trajectories (i.e., "Average Stable" with $d = 0.47$ vs. "Low Increasing" with $d = 1.64$ and "Low Decreasing" with $d = 1.90$). In addition, the children in the "Average Stable" trajectory had a better initial reading skills than those in the "Low Increasing" ($d = 1.18$) and "Low Decreasing" ($d = 1.43$) trajectories. The reading skills of the children in the "Low Increasing" and "Low Decreasing" trajectories did not differ ($d = 0.26$). These effect sizes, which ranged from intermediate to strong (Cohen, 1988), provided support for our hypothesis that children with different initial reading

Table 2
Latent growth curve models of reading self-efficacy and sources of reading self-efficacy.

	Intercept		Slope		Covariance between Intercept and Slope	Model fit indexes[b]
	Mean	Variance	Mean	Variance		
Reading self-efficacy[a]						Linear model
Estimate	5.86***	0.89***	0.09***	0.11***	−0.13*	$\chi^2(1) = 2.11$
SE	0.05	0.10	0.02	0.04	0.05	CFI = 1.00, TLI = 0.99
Sources of self-efficacy[a]						
Mastery experience						Non-linear model
Estimate	5.73***	1.51***	−0.02	0.65 ***	−0.58***	$\chi^2(2) = 0.01$
SE	0.04	0.07	0.03	0.07	0.05	CFI = 1.00, TLI = 1.00
Verbal persuasion						Non-linear model
Estimate	4.86***	2.55***	−0.34***	1.34***	−0.93***	$\chi^2(2) = 0.94$
SE	0.07	0.10	0.04	0.09	0.07	CFI = 1.00, TLI = 1.00
Vicarious experience						Non-linear model
Estimate	4.75***	3.03***	−0.52***	1.73***	−1.18***	$\chi^2(2) = 2.71$
SE	0.08	0.09	0.05	0.10	0.08	CFI = 1.00, TLI = 1.00
Physiological and emotional states						Non-linear model
Estimate	1.99***	0.89	−0.21***	0.27	−0.09	$\chi^2(1) = 1.21$
SE	0.05	0.42	0.04	0.42	0.44	CFI = 1.00, TLI = 1.00

Note. [a]Scales for all variables ranged from 1 to 7. [b]Model fit indexes correspond to the competing latent growth models. Non-linear model of self-efficacy, $\chi^2(1) = 13.41$, CFI = 0.97, TLI = 0.91; Linear models for mastery experience, ($\chi^2(1) = 0.03$, CFI = 1.00, TLI = 1.00); verbal persuasion, ($\chi^2(1) = 18.28$, CFI = 0.98, TLI = 0.95); vicarious experience, ($\chi^2(1) = 36.39$, CFI = 0.96, TLI = 0.89); and physiological and emotional states, ($\chi^2(1) = 7.99$, CFI = 0.97, TLI = 0.92).
*$p < .05$, **$p < .01$, ***$p < .001$.

Table 3
Summary of Fit Statistics for Different Growth Mixture Models of Reading Self-Efficacy.

Number of trajectories	LLR	BIC	aBIC	VLMR *p*-value	LMR *p*-value	Entropy	Trajectory sample sizes based on posterior probabilities
1	−4988.001	10076.660	10032.189	–	–	–	–
2	−4792.607	9707.443	9653.442	0.0000	0.0000	0.93	103/1223
3	−4679.482	9502.762	9439.231	0.1170	0.1256	0.90	138/81/1107
4	**−4619.543**	**9404.454**	**9331.393**	**0.0324**	**0.0360**	**0.87**	**164/995/48/119**
5	−4563.505	9313.949	9231.359	0.0881	0.0961	0.88	16/43/157/130/980
6	−4523.834	9256.176	9164.056	0.2836	0.2977	0.88	45/130/956/152/16/26
7	−4499.192	9228.461	9126.811	0.3284	0.3384	0.86	30/36/914/17/129/76/124

Note. LLR = log-likelihood ratio; BIC = Bayesian information criterion; aBIC = sample-size adjusted Bayesian information criterion; VLMR = Vuong-Lo-Mendell-Rubin likelihood ratio test; LMR = Lo-Mendell-Rubin likelihood ratio test. Estimates of the chosen four factor solution are bolded.

Table 4
Estimated Proportion of Students, and Mean Level and Slope of Reading Self-Efficacy Latent Growth Curve Model, by Self-Efficacy Trajectories.

	Reading Self-Efficacy Trajectories			
	High Increasing	Average Stable	Low Increasing	Low Decreasing
Trajectory *n* (estimated proportion of students)[a]	1007 (75.9%)	153 (11.5%)	121 (9.1%)	45 (3.4%)
Average posterior probability	0.96	0.83	0.82	0.93
Level mean	5.75***	5.05***	3.11***	3.68***
Slope mean	0.37***	−0.14	1.22***	−0.57**

*$p < .05$, **$p < .01$, ***$p < .001$.
[a]Values obtained from classification of students based on their most likely trajectory membership.

skill levels would differ by reading self-efficacy trajectories (H3).

3.4. Changes in sources of self-efficacy in relation to reading self-efficacy trajectories

To answer our final research question, two phases of analysis were conducted. In the first phase, we examined changes in the sources of self-efficacy. We conducted LGMs separately for each of the sources of self-efficacy (mastery experience, verbal persuasion, vicarious experience, and physiological and emotional states). The fit indices and estimated parameters of the LGMs are presented in Table 2 (i.e. means and variances of the level and slope for each source of self-efficacy). A model including the initial level and a nonlinear slope fit the data well for each source of self-efficacy (see Table 2). On average, mastery experience did not change during the study period. However, statistically significant variability was observed between the students with regard to the level of mastery experience as well as the rate of change. Verbal persuasion, vicarious experience, and physiological and emotional states showed declining patterns over the study period. In terms of physiological and emotional states, this indicated that the students experienced less adverse physiological arousal and emotional states (e.g., anxiety) in reading over time. In addition, the students differed in the rates at which their sources of self-efficacy declined over the study period. For mastery experience, verbal persuasion, and vicarious experience, higher initial levels were related to faster rates of decline over time. However, in physiological and emotional states, the rate of decline was similar for all the students and unrelated to the initial levels of arousal reported by them.

In the second phase, which is pertinent to answering our primary question of interest, we examined whether the initial levels of and rates of changes in the sources of self-efficacy differed according to the students' reading self-efficacy trajectories (i.e., the four trajectory patterns described above). The estimated means of the level and slope of each source by self-efficacy trajectory are reported in Table 5 and are graphically illustrated in Fig. 2. All the LR tests were significant at $p < .01$, indicating that the students' self-efficacy trajectories differed as a function of the initial level and mean rate of change for each source of self-efficacy (Table 5). In other words, both the initial levels of the

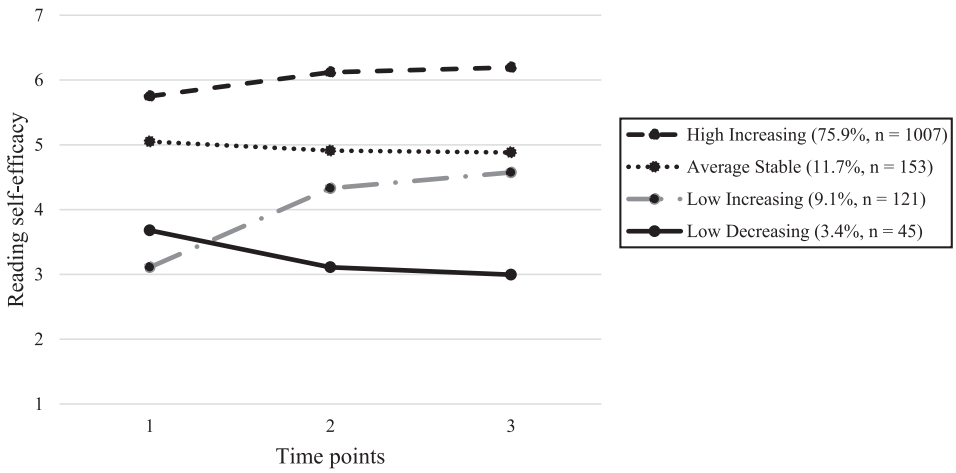

Fig. 1. Self-Efficacy Scores by Self-Efficacy Trajectories between Time Points T1–T3. *Note.* Self-efficacy trajectory groups were labeled as High Increasing, Average Stable, Low Increasing and Low Decreasing.

Table 5
Estimated Means of Level and Slope of Sources of Self-Efficacy and of Level of Reading by Self-Efficacy Trajectories: Comparisons between Self-Efficacy Trajectories conducted via BCH method.

		Self-Efficacy Trajectories				
	Log-likelihood ratio test	High Increasing (1)	Average Stable (2)	Low Increasing (3)	Low Decreasing (4)	Comparisons between Self-Efficacy Trajectories[c]
Reading level[a]						
		0.17***	−0.12	−0.85***	−1.00***	4, 3 < 2 < 1
Sources of Self-Efficacy						
Mastery experience[b]	$\chi^2(6) = 155.10$***					
Level		6.15**	5.39***	4.53***	4.53***	4, 3 < 2 < 1
Slope		0.33	0.55*	0.34*	−0.09	4 < 2
Verbal persuasion[b]	$\chi^2(6) = 50.74$***					
Level		6.31***	5.74***	5.46***	5.60***	4, 3, 2 < 1
Slope		−0.24	−0.33	−0.16	−0.86*	4 < 1, 3
Vicarious experience[b]	$\chi^2(6) = 18.29$**					
Level		6.12***	5.75***	5.73***	5.86***	2 < 1
Slope		−0.42	−0.55	−0.18	−0.94**	4 < 3
Physiological and emotional states[b]	$\chi^2(6) = 51.76$***					
Level		2.05***	2.31***	2.89***	3.53***	1, 2 < 4, 3
Slope		−0.50**	−0.31	−0.64**	−0.89**	4 < 2

Note. [a]Reading test scores standardized within each grade level prior to the analysis. [b]Scale from 1 to 7. In physiological and emotional states, higher scores refer to more adverse physiological arousal. [c]Pairwise comparisons based on Wald's test. Only significant comparisons are presented.
*$p < .05$, **$p < .01$, ***$p < .001$.

students' exposure to efficacy-relevant information and the manner in which their exposures changed over time were related to the students' reading self-efficacy trajectories. The results for the variables controlled in each model are reported in Appendix D.

Next, we focused on the differences in the levels of sources of self-efficacy reported by the students in each of the four self-efficacy trajectories. Pairwise comparisons between the trajectories indicated that the children in the "High Increasing" trajectory had higher initial levels of mastery experiences and verbal persuasions than those in the other trajectories (the trajectory comparisons are presented in Table 5, and the Wald tests for pairwise comparisons, in Table 6). In addition, the children in the "High Increasing" trajectory reported more vicarious experiences compared to those in the "Low Increasing" trajectory, and they had lower initial levels of physiological and emotional states compared to the students in the "Low Increasing" and "Low Decreasing" trajectories. The children in both the low self-efficacy trajectories (be it "Low Increasing" or "Low Decreasing") reported similar initial levels of exposure to each source of self-efficacy. The effect sizes reflecting the differences in the initial level of each source of self-efficacy as a function of the children's self-efficacy trajectories ranged from intermediate to strong (Cohen, 1988). These effect sizes (see Table 6) pointed to substantial differences in the children's initial exposures to each of the four sources of self-efficacy, which relate to corresponding increases or decreases in the children's reading self-efficacy over time. These findings were in line with our hypotheses (H4 and H5).

Last, we examined the differences in the rates of change (i.e., slopes) in the sources of self-efficacy over time as a function of the students' self-efficacy trajectories. The average rate of change in the mastery experiences differed only between the "Average Stable" and "Low Decreasing" self-efficacy trajectories (see Table 6 for the Wald tests for pairwise comparisons and effect sizes). The children in the "Average Stable" trajectory reported increasing mastery experiences over the study period, whereas those in the "Low Decreasing" trajectory reported no significant change in perceived mastery experiences. However, these children in "Low Decreasing" trajectoryreported diminishing verbal persuasions over the study period compared to children in either of the increasing self-efficacy trajectories. Similarly, the children in the "Low Decreasing" trajectory reported decreasing vicarious experiences over the study period in comparison to those in the "Low Increasing" trajectory. Only one significant difference emerged between the self-

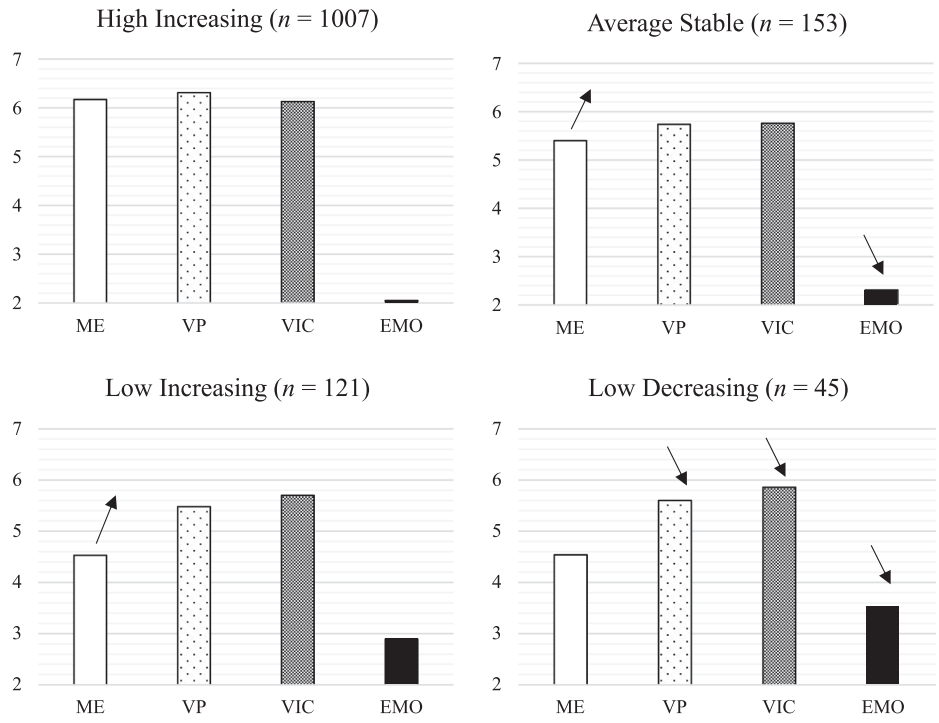

Fig. 2. Estimated Mean Levels of Each Source of Self-Efficacy by Self-Efficacy Trajectories over Three Time Points. *Note.* Arrows represent significant change over time in the sources of self-efficacy. Arrows pointing upward represent an increase over the study period and arrows pointing downward represent a decrease over the study period. ME = Mastery experience, VP = Verbal persuasion, VIC = Vicarious experience, EMO = Physiological and emotional state.

Table 6
Effects Sizes based on Pairwise Comparisons of the Estimated Means of Level and Slope of Sources of Self-Efficacy by Self-Efficacy Trajectories.

Trajectory Comparisons[a]	Mastery experience		Verbal persuasion		Vicarious experience		Physiological and emotional states	
	Wald	Cohen's *d*	Wald	Cohen's *d*	Wald	Cohen's *d*	Wald	Cohen's *d*
Level								
1 vs 2	20.23***	**0.39**	9.85**	**0.21**	4.09*	**0.12**	2.58	0.44
1 vs 3	48.83***	**0.83**	11.63***	**0.31**	2.58	0.13	17.43***	**1.40**
1 vs 4	39.60***	**0.82**	5.51*	**0.26**	0.77	0.09	19.95***	**2.50**
2 vs 3	7.41**	**0.44**	0.89	0.10	0.01	0.01	5.64*	**0.96**
2 vs 4	8.97**	**0.44**	0.16	0.05	0.10	0.04	12.15***	**2.04**
3 vs 4	0.00	0.00	0.16	0.05	0.14	0.04	3.20	1.08
Slope								
1 vs 2	1.35	0.12	0.23	0.05	0.43	0.06	2.13	1.13
1 vs 3	0.00	0.02	0.16	0.05	1.23	0.12	0.54	0.79
1 vs 4	2.79	0.31	5.93*	**0.34**	3.64	0.26	2.54	2.29
2 vs 3	0.52	0.14	0.42	0.10	1.80	0.09	2.19	1.92
2 vs 4	3.94*	**0.43**	2.57	0.29	1.49	0.31	5.41*	**3.40**
3 vs 4	1.41	0.29	5.02*	**0.39**	5.61*	**0.40**	0.77	1.50

[a]Self-efficacy Trajectories: 1= "High Increasing", 2 = "Average Stable", 3 = "Low Increasing", 4 = "Low Decreasing". Significant effect sizes are bolded.
*$p < .05$, **$p < .01$, ***$p < .001$.

efficacy trajectories with regard to the students' physiological and emotional states over time: the children in the "Low Decreasing" trajectory reported diminishing negative physiological and emotional states in comparison to those in the "Average Stable" trajectory. Overall, the intermediate effect sizes (Cohen, 1988) indicated that changes in the children's self-efficacy over time depended partly on the differences in their longitudinal exposures to efficacy-relevant experiences (see Table 6).

4. Discussion

This study extends previous research on self-efficacy development by examining how efficacy beliefs form and change in the early stages of learners' school careers. We examined self-efficacy and its hypothesized sources among primary school children and focused on beliefs about reading fluency, which is a less studied context in the field of self-efficacy research. More specifically, we examined how reading self-efficacy changes over time using both variable-centered and person-centered analyses. By adopting a person-centered approach with longitudinal data, we identified differing trajectories of reading self-efficacy development and examined how changes in the sources of self-efficacy relate to these trajectories. In addition, we examined the association between children's initial reading fluency levels and their subsequent self-efficacy development.

4.1. Increase in reading self-efficacy over time

The results from our variable-centered analyses indicated that reading self-efficacy was not a stable characteristic among our primary school students. Rather, the children's reading self-efficacy changed

over a 11-month study period that spanned 2 grade levels. We were pleased to see that, in general, the children's beliefs about their capability to read fluently increased over the study period. This finding is similar to that reported for secondary school students' reading self-efficacy (Schöber et al., 2018) and is in line with research conducted with primary school children in other contexts (e.g., Hornstra et al., 2016; Phan, 2012a, 2012b).

4.2. Distinct trajectories of change in reading self-efficacy

Our person-centered analyses offered a more nuanced understanding of children's self-efficacy development by permitting us to model differences in the level, direction, and rate of change in self-efficacy for each student (see Bergman & Trost, 2006; Howard & Hoffman, 2018; Woo et al., 2018). Four distinct trajectories of change in reading self-efficacy emerged from the data. The children in two of the trajectories showed increasing self-efficacy over the study period—one trajectory was characterized by high initial self-efficacy levels, and the other, by low initial levels. A third trajectory was characterized by average initial levels of self-efficacy that remained relatively stable over time. A fourth self-efficacy trajectory, and that with the smallest number of children, was characterized by low initial self-efficacy levels, which decreased over time. This last pattern of decline in reading self-efficacy, although characteristic of a minority of the studied children, is nevertheless worth paying particular attention to, as discussed below. Notably, the variability in the children's self-efficacy development that we modeled in this study would have remained hidden if we would have conducted mean-level and variable-centered analyses only.

Our results depict changes in the children's beliefs about their capabilities to successfully perform everyday reading tasks. We found substantial variability in changes in self-efficacy, showing both increasing and declining trajectories at this level of measurement specificity, which followed the operationalization of self-efficacy as a task-specific judgment of one's capabilities (Bandura, 1997; see also Schunk & DiBenedetto, 2020). Previous studies have primarily examined either reading self-efficacy at a domain/general level (e.g., *I'm a good reader*) in a cross-sectional manner (e.g., Lee & Zentall, 2015; Smith et al., 2012; Wigfield, Guthrie, Tonks, & Perencevich, 2004) or longitudinally (in one case only; Schöber et al., 2018). When a more general level of specificity in reading ability beliefs is used, researchers have reached somewhat different conclusions. For example, the developmental trajectories in children's ability self-concepts in literacy were shown to decline from Grades 1–12, although the rate of decline differed (Archambault et al., 2010). Some researchers have suggested that task-specific self-efficacy may be more sensitive to change than domain-general self-efficacy (Marsh et al., 2019; see also Unrau et al., 2017). That is, specific efficacy beliefs are more prone to change from day to day (i.e., more state-like) compared to more general beliefs, which tend to be stable over time (i.e., more trait-like). The relationships between specificity of measurement and changes in self-efficacy over time warrant further investigation.

4.3. Dynamic interplay between sources of self-efficacy and self-efficacy

The children's reported exposure to the efficacy-building experiences and their changes over time were found to vary according to fluctuations in their self-efficacy. Thus, our findings not only confirm but also extend those reported in cross-sectional studies, which indicate that the sources of self-efficacy and self-efficacy are related (see, e.g., Sheu et al., 2018; Usher & Pajares, 2008) by pointing to the dynamic interplay of these variables. Our findings are well understood in light of Bandura (1997) social cognitive model of reciprocal determinism (see also Schunk & DiBenedetto, 2020). As Bandura explained, "the extent to which people will alter their perceived efficacy through performance experiences depends upon, among other factors, their preconceptions of their capabilities" (p. 81).

Not surprisingly, the children with initially high and increasing levels of reading self-efficacy reported more efficacy-building experiences than those with other trajectories. These high-self-efficacy students reported experiencing mastery in reading tasks, receiving positive feedback on their reading skills, seeing other good readers, and experiencing low and further diminishing negative affective arousal in reading situations. Similar patterns have been observed in cross-sectional studies in the context of science, math, and reading (Butz & Usher, 2015; Chen & Usher, 2013). Furthermore, our findings revealed that the children's high levels of positive efficacy-building experiences were maintained over time. Not surprisingly, these children possessed an initial reading skill level that was higher compared to those of the students in the other self-efficacy trajectories. Good readers may be more likely to experience efficacy-building events or messages that would enable them to build confidence, and they presumably perceive and interpret these experiences in ways that support positive self-efficacy development (see also Usher & Pajares, 2006). As theorized, prior skills convey a sense of mastery, enhancing self-efficacy, which in turn likely initiates skill development. It is encouraging that most of the children in our sample were experiencing this positive self-belief cycle in reading.

By contrast, the children in the two trajectories with self-efficacy levels that were relatively lower likewise reported lower initial levels of mastery experiences and encouragement from others. They had lower reading skills than the students with high and average initial self-efficacy. These findings are consistent with those from previous cross-sectional research (Butz & Usher, 2015; Chen & Usher, 2013). Taken together, these findings suggest that attention should be paid to how poor readers perceive feedback and the social persuasions received from others as well as how they interpret their performance in reading tasks. Lower-performing children may need more explicit support to create positive efficacy-building experiences in reading. In addition, high levels of anxiety and tension in reading situations were related to lower perceived efficacy in reading. Previous studies that examined reading using variable-centered approaches did not find this association to be prominent (Butz & Usher, 2015). Negative arousal related to mathematics (mathematics anxiety) is well known and has been found to be related to perceived self-efficacy in mathematics (e.g., Phan, 2012b; Usher & Pajares, 2009; Usher et al., 2019).

These implications become more evident in light of our findings for particular types of efficacy-relevant experiences. Among the children who showed a negative trend in their self-efficacy over time, their persistently low self-efficacy was related to declining exposure to social sources of self-efficacy over time (i.e., verbal persuasions and vicarious experiences). That is, these children either perceived or experienced less social support over time (i.e., received fewer positive verbal persuasions). In previous studies, students' perceptions of teacher support have predicted changes in motivational profiles (Lazarides, Dietrich, & Taskinen, 2019), and teachers' perceptions of students' abilities have been related to children's developing perceptions of their reading abilities (Upadyaya & Eccles, 2015). Our findings extend this line of evidence by suggesting that perceived lack of social support over time can be harmful to children's self-efficacy development.

Moreover, decreasing exposure over time to social models who are skilled readers was related to declining self-efficacy in reading. One explanation for this finding is that children with low self-efficacy and low reading skills may not seek out more proficient models, as the latter's successes might induce feelings of despair. As our items focused only on exposure to proficient models (e.g., *Seeing kids do better than me in reading pushes me to do better*), they did not enable us to assess the degree to which students with low self-efficacy were exposed to struggling readers who may have reinforced their self-doubts (see Usher & Weidner, 2018). Furthermore, exposure to peer and adult models who make errors and who overcome difficulties (i.e., coping models; Pajares, 2006; Schunk, Hanson, & Cox, 1987), may be especially beneficial for low-performing children's self-efficacy development (Schunk et al.,

1987). In reading particularly, seeing similar others succeed is found to be an important source for reading self-efficacy for low-performing students (Usher & Pajares, 2006).

In addition, children with decreasing self-efficacy reported low levels of perceived mastery experience over time, possibly suggesting that the task demands in reading were not at an optimal level for ensuring their incremental success. Differentiated reading instruction might make it more likely for struggling readers to experience and witness their own skill development, albeit at a slower pace. Such mastery experiences can ward off a persistently low self-efficacy, which has been shown to lead to avoidance of challenging tasks and lack of effort or persistence (Galla et al., 2014; Schnell et al., 2015).

Our findings indicate that longitudinal designs and person-centered approaches can extend the current state of knowledge on self-efficacy development. For most of the students in our sample, the changes in self-efficacy were positive and associated with high levels of efficacy-building experiences and high initial reading skills. For the students whose self-efficacy was low, on the other hand, these relationships were not as clear. We found no relationship between the initial levels of sources of self-efficacy or reading skills and negative trajectories of self-efficacy. Rather, the students' persistently low self-efficacy was associated with a decline in exposure to the social sources of self-efficacy over time. The context-dependent variability in the longitudinal interplay between changes in self-efficacy and changes in the sources of self-efficacy might partially explain the inconsistent findings reported in the few previous longitudinal investigations of these variables (2012b; Phan, 2012a).

4.4. Implications

From the viewpoint of teaching, our findings offer several important insights on how efficacy beliefs form and change in primary school and the individual variabilities in those changes. First, the self-efficacy trajectories that emerged varied by students' exposures to the sources of self-efficacy. Teachers often provide considerable instructional scaffolding and support for reading at the beginning of the school year, but over time, much of that support diminishes. Ongoing instructional supports that target each of the four efficacy-relevant sources would ensure that children have opportunities to build not only their skills, but their self-efficacy as well.

Second, fewer perceived social sources of self-efficacy support may be especially detrimental to children who already perceive themselves as poor readers. These children would likely benefit from individualized social and academic supports that would help them regain or maintain their self-efficacy in reading. Such supports could include ongoing and explicit positive feedback of the development of their reading skills from teachers and parents. In addition, ensuring exposure to coping models with whom children can identify with when they struggle, could help build their confidence in reading, as Schunk and colleagues' (Schunk & Hanson, 1985; Schunk et al., 1987) early experiments in math suggest. It bears noting that many children with low self-efficacy have become convinced that nothing can raise their self-efficacy (Usher et al., 2019). Thus, researchers should further examine the extent to which learners in the most at-risk self-efficacy trajectories are responsive to social supports and instructional interventions.

Third, our findings suggest that teachers should be aware of the heterogeneity in self-efficacy development. The provision of diverse opportunities to support students' self-efficacy—at varying times and in ways sensitive to diverse student needs—will yield the best results. In other words, a one-size-fits-all approach to supporting self-efficacy development would likely be ineffective.

4.5. Limitations and future directions

Several limitations in this work should be taken into account in future research. First, the study period of 11 months was rather short for investigating changes in self-efficacy and efficacy-building experiences. Longitudinal studies with longer follow-ups would offer a more comprehensive picture of the developmental trends and trajectories of efficacy beliefs. On the other hand, examining variations in reading-related efficacy beliefs intensively during learning situations and from day to day (e.g., via experience sampling methods) would provide a more detailed account of how pedagogical practices, such as feedback, affect students' self-beliefs in reading.

Second, self-efficacy might be more likely to change and efficacy-building experiences might be more beneficial at certain points during the school year than others. Our study did not consider the ways in which students may have weighted and integrated efficacy-relevant information at each time interval. Further research could help identify the point at which efficacy-building experiences induce detectable changes in learners' beliefs. Furthermore, researchers should consider what types of experiences might be *lowering* children's confidence in reading, which we did not focus on in this work.

Third, we did not consider the factors that might mediate or moderate the relationships between sources of self-efficacy and self-efficacy over time. Such factors might be related to both environmental (e.g., social norms, pedagogical practices, and parenting style) and personal (e.g., ability mindsets and identity) characteristics (Usher & Weidner, 2018). For example, a child with a fixed ability mindset might not change his efficacy beliefs despite being exposed to many efficacy-building experiences (Chen & Usher, 2013). Other methodological approaches, such as targeted interviews with children, teachers, or parents, could be useful for understanding why, for whom, and how reading self-efficacy changes.

Fourth, we used a person-centered approach (see Bergman & Trost, 2006; Howard & Hoffman, 2018) for studying individual differences in self-efficacy development. However, for the sake of interpretability, we elected to use a variable-centered approach for modeling the sources of self-efficacy. Future work should consider the variabilities regarding the development of the sources of self-efficacy as well as the relationships between these sources and self-efficacy. These findings could enrich our understanding of the dynamic changes in both the sources and self-efficacy over time. In addition, future work might consider how skill development affects children's perceptions and interpretations of efficacy-building experiences together with changes in their self-efficacy.

Lastly, to ensure that our findings did not depend on the children's developmental levels, we controlled for grade level in all the analyses. However, this leaves open the question of whether changes in the variables and their relationships might have been moderated by these group characteristics. Examining the differences in the changes between developmental phases (e.g., at the beginning of schooling and in transition phases) might reveal a more nuanced picture of age-related differences in self-efficacy development.

5. Conclusion

This study is among the first to use a longitudinal and person-centered approach to investigate the development of children's reading self-efficacy. Our findings indicate substantial variabilities in the level, direction, and rate of change of primary school students' reading self-efficacies over time, which highlights the need for person-centered approaches in understanding self-efficacy development. Importantly, efficacy-building experiences and changes in them were found to be associated with the students' self-efficacy trajectories. To identify and support young readers—particularly those who harbor self-doubt—teachers should be sensitive to changes in self-efficacy as well as changes in how students perceive efficacy-building experiences. Educational practices that permit teachers to address the needs of different groups of students, such as differentiated instruction, may best support self-efficacy.

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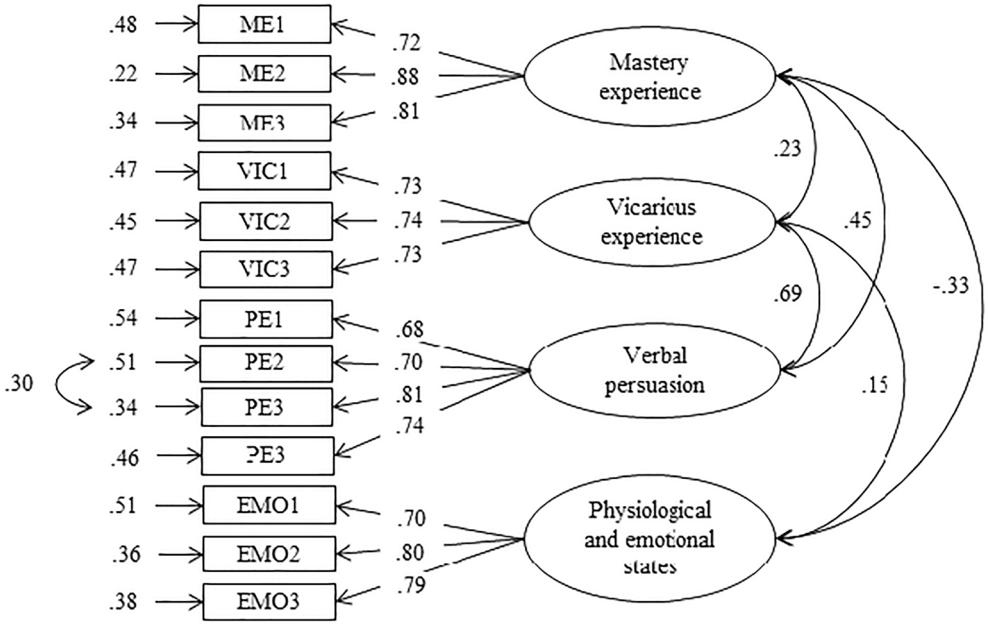
Appendix A

Four-Factor Structure of Sources of Reading Self-Efficacy



Note. ME = Mastery experience, VIC = Vicarious experience, PE = Verbal persuasion, EMO = Physiological and emotional states. Standardized estimates and only significant estimates are presented.

Appendix B

The invariance of the sources of self-efficacy was tested by comparing the fit of the baseline model (i.e., parameters of the model were freely estimated in all grade levels) to that of the constrained model (i.e., parameters were constrained to be equal across grade levels), using the Satorra-Bentler scaled χ^2 test (Satorra & Bentler, 2001). A statistically significant χ^2 difference test ($p < .05$) denotes that the model with fewer constraints fits better with the data, whereas statistically non-significant χ^2 difference test denotes that the model with more constraints fits better with the data. However, because the χ^2 test is sensitive to large sample size, the CFI, RMSEA, and SRMR criteria (see Chen, 2007; Cheung & Rensvold, 2002; MacCallum, Browne, & Cai, 2006) were also used. A change smaller than −0.01 in CFI supplemented by a change of smaller than 0.015 in RMSEA and smaller than 0.03 in SRMR indicates that the hypothesis of invariance of factor loadings or intercepts should not be rejected, even though the χ^2 test indicates a statistically significant result.

Invariance Comparisons of the Sources of Self-efficacy by Grade Level

Model	χ^2	*df*	*CFI*	*TLI*	*RMSEA 90%. C.I.*	*SRMR*	χ^2 difference test	*ΔCFI/ΔRMSEA/ΔSRMR*
Invariance of the Sources of Self-efficacy Model								
1 Unconstrained model	342.704***	232	0.979	0.971	0.039 0.030–0.047	0.043	–	–
2 Loadings set to be equal	379.265***	259	0.977	0.972	0.038 0.030–0.046	0.050	χ^2 (27) = 36.661, $p = .10$	−80.002/0.001/0.007
3 Loadings and intercepts set to be equal	437.108***	286	0.971	0.968	0.041 0.033–0.048	0.053	χ^2 (27) = 58.133, $p < .001$	−80.006/0.003/0.003

Note. In χ^2 difference test and *ΔCFI/ΔRMSEA/ΔSRMR* model compared to previous, less constrained model.
*** $p < 0.001$

Appendix C. Sources of reading self-efficacy scale

Original items in Finnish	Translated items	Original items (Usher & Pajares, 2009)
Mastery experience		
Olen aina ollut hyvä lukija.	I have always been a good reader.	I have always been successful with math.
Osaan lukea hyvin.	I do well on reading.	I do well on math assignments.

(*continued on next page*)

(*continued*)

Original items in Finnish	Translated items	Original items (Usher & Pajares, 2009)
Osaan lukea hyvin vaikeitakin tekstejä.	I do well on reading even the most difficult texts.	I do well on even the most difficult math assignments
Social persuasion		
Opettajani on usein kehunut siitä, että lukutaitoni on parantunut.	My teacher has often told that I am getting better in reading.	My math teachers have told that I am good at learning math.
Vanhempani sanovat usein, että olen hyvä lukija.	My parents have often told me what a good reader I am.	Adults in my family have told me what a good math student I am.
Lukutaitoani on usein kehuttu.	I have been praised for my reading skills.	I have been praised for my ability in math.
Luokkakaverit ovat sanoneet, että olen hyvä lukija.	My classmates have told me that I'm a good reader.	Other students have told me that I'm good at learning math.
Vicarious experience		
Kun näen toisten lasten olevan parempia lukijoita, se saa minutkin harjoittelemaan lukemista.	Seeing kids do better than me in reading pushes me to do better.	Seeing kids do better than me in math pushes me to do better.
Ajattelen usein, että jonain päivänä olen taitava lukija.	I often imagine myself being a good reader.	I imagine myself working through challenging math problems successfully.
Ihailen aikuisia, jotka ovat hyviä lukijoita.	I admire adults who are good readers.	(not in the original scale)
Physiological and emotional states		
Ahdistun, kun tiedän, että joudun lukemaan ääneen tunnilla.	I get anxious when I know that I have to read aloud during class.	(not in the original scale)
Ahdistun, kun aloitan lukemisen.	I start to feel anxious as soon as I begin to read.	I start to feel stressed-out as soon as I begin my math work.
Tunnen kehossani jännitystä, kun minun pitää lukea.	I feel tension in my body when I have to read.	My whole body becomes tense when I have to do math.

Note. The original items (Usher & Pajares, 2009) were translated from English to Finnish and then adapted for the reading context and primary school children. The items were then back-translated to English.

Appendix D. Results concerning model covariates

	Self-efficacy		Mastery experience		Verbal persuasion		Vicarious experience		Physiological and emotional states	
Covariates	Level	Slope	Level	Slope	Level	Slope	Level	Slope	Level	Slope
Grade level	0.24**	−0.31	−0.05		−0.08	−0.19**	−0.30***	−0.09	−0.08	0.06
Gender[a]	0.13*	−0.30	0.09***	0.11***	−0.15	0.03	−0.78***	0.07	−0.09	−0.09
Intervention status[a]	−0.05	0.03	0.02	0.04	0.08***	0.68***	−0.07	0.32	0.71*	0.00

Note. [a]Gender and intervention status were recoded for the analyses (0 = girl, 1 = boys; 0 = no intervention, 1 = intervention).
*$p < .05$, **$p < .01$, ***$p < .001$.

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