JYX
JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

This is a self-archived version of an original article. This version may differ from the original in pagination and typographic details.

Author(s): Torppa, Minna; Aro, Tuija; Eklund, Kenneth; Parrila, Rauno; Eloranta, Anna-Kaija; Ahonen, Timo

Title: Adolescent reading and math skills and self-concept beliefs as predictors of age 20 emotional well-being

Year: 2023

Version: Published version

Copyright: © The Author(s) 2023

Rights: CC BY 4.0

Rights url: https://creativecommons.org/licenses/by/4.0/

Please cite the original version:

Torppa, M., Aro, T., Eklund, K., Parrila, R., Eloranta, A.-K., & Ahonen, T. (2023). Adolescent reading and math skills and self-concept beliefs as predictors of age 20 emotional well-being. Reading and Writing, Early online. https://doi.org/10.1007/s11145-023-10461-z

Reading and Writing
https://doi.org/10.1007/s11145-023-10461-z

Adolescent reading and math skills and self-concept beliefs as predictors of age 20 emotional well-being

Minna Torppa[1] · Tuija Aro[1] · Kenneth Eklund[1] · Rauno Parrila[2] · Anna-Kaija Eloranta[1] · Timo Ahonen[1]

Accepted: 31 May 2023
© The Author(s) 2023

Abstract

This study examines longitudinal associations among reading skills, math skills and emotional well-being in a Finnish sample (n = 586) followed from the end of comprehensive school (Grade 9, age 15–16) to age 20. In particular, we determine whether the associations between skills and well-being are mediated by self-concept beliefs. In Grade 9, the participants' reading fluency, PISA reading comprehension and math skills were assessed in classrooms, and questionnaires were used to assess self-concept (global and skill-specific) and internalising problems. At age 20, questionnaires were used to self-report emotional well-being and educational attainment. The results showed no direct predictive association between academic skills and age-20 emotional well-being, while indirect effects from academic skills on emotional well-being were found for reading skills through reading comprehension self-concept belief and educational attainment and for math skills through global self-concept belief. In addition, adolescent global self-concept and internalising problems predicted age-20 emotional well-being. The results suggest that adolescent self-concept beliefs and internalising problems, rather than academic skills per se, can predict emotional problems in young adulthood.

Keywords Reading fluency · Reading comprehension · Mathematics · Self-concept beliefs · Emotional well-being

Proficiency in basic academic skills (i.e. reading and mathematics) is required in education and in the everyday lives of people. As these skills are so essential, learn-

✉ Minna Torppa
minna.p.torppa@jyu.fi

[1] University on Jyväskylä, Jyväskylä, Finland

[2] Australian Catholic University, Ballarat, Australia

Published online: 10 July 2023

ing difficulties in reading and mathematics can increase the risk of multiple negative outcomes, including having delays or dropping out in educational paths (Aro et al., 2019; Hakkarainen et al., 2016) and psychological ill-being (e.g., Francis et al., 2019). While the mechanism by which academic skills affect the selection of educational paths that require advanced academic skills is obvious, the mechanisms linking skills and well-being are less clear. The present study examines one hypothesised pathway: the mediating role of self-concept between academic skills and emotional well-being (e.g., McArthur et al., 2020). In addition, we examine whether educational attainment affects the association between skills and well-being by focusing on the developmental period from age 15–16 to age 20, when the participants are expected to transition from comprehensive school to secondary school and from secondary school to tertiary education or labour market. This is thus a particularly important period for young people's future and, as such, a potential period for the development of an association among academic skills, self-concept beliefs, educational attainment and emotional well-being.

In the literature, multiple concepts are used to define and measure psychological well-being, including mental health, psychiatric symptoms and psychosocial well-being or ill-being. In this study, we use the concept of emotional well-being. It refers to the measures of subjective experiences of mental well-being (Tennant et al., 2007) and internalising types of problems (Cicchetti & Toth, 1991) that represent inner-directed emotions, such as anxiety, worry and sorrow (Hinshaw, 1992; Zahn-Waxler et al., 2000). Problems in emotional well-being, particularly depression and anxiety, have been shown to co-occur with reading difficulties in childhood (e.g., Carroll and Iles, 2006; Francis et al., 2019; Nelson et al., 2015) and later in life (e.g., Aro et al., 2019; Davis et al., 2009; Raskind et al., 1999). There is also preliminary evidence that mathematical skills and difficulties are linked with emotional well-being among children (e.g., Aro et al., 2022; Wakeman et al., 2022; Willcutt et al., 2013), adolescents (Parhiala et al., 2018) and adults (Aro et al., 2019; Wilson et al., 2009). The findings are, however, mixed for various possible reasons – including the sample characteristics, measurement differences and study contexts – and no study has found evidence for the association between academic achievement and emotional well-being measures (Auerbach et al., 2008; Carroll et al., 2005; Parhiala et al., 2015; see review in Francis et al., 2019).

This study makes the following contributions to the literature. First, we examine longitudinal associations in a large sample over a five-year period, from adolescence (Grade 9, age 15–16) to young adulthood (age 20). Most previous research on the association between academic achievement and emotional well-being has been cross-sectional, correlational studies or compared small samples of individuals with and without learning difficulties. As our longitudinal model also includes an emotional well-being measure at both time points, we can provide a more robust examination of the potential impact of academic skills on emotional well-being than is possible with a cross-sectional design or in a longitudinal study with emotional well-being assessed only as an outcome. Second, focusing on this developmental phase has been rare despite its potential long-term importance for the development of emotional well-being. The few previous longitudinal studies spanning adulthood have indicated that a considerable percentage of individuals with a history of learning difficulties also

show mental health problems in adulthood (Aro et al., 2019, 2023; Klassen et al., 2013). In this study, we add to this knowledge by examining the full skill distribution instead of comparing individuals with and without learning difficulties. Third, unlike most previous studies, we include multiple academic skill domains, namely reading fluency, reading comprehension and math skills, to examine their unique and combined effects on emotional well-being. Fourth, we test the hypothesis that self-concept beliefs mediate the association between skills and emotional well-being and examine a hypothesis for the mechanism explaining the often-found correlation between academic skills and emotional well-being (e.g., McArthur et al., 2020). Finally, we control for the effect of educational attainment (vocational or academic secondary school completed by age 20 as expected or not completed) and examine whether it mediates the effects of academic skills and self-concept beliefs on emotional well-being. The associations are examined by testing the hypothesised model depicted in Fig. 1.

Role of self-concept beliefs as mediators between academic skills and emotional well-being

Self-concept beliefs may be a key pathway linking problems in academic skills and emotional well-being. 'Self-concept' refers to a person's beliefs about themselves and develops in interaction with one's environment (Marsh & Shavelson, 1985). There are various self-concept domains, that is, separate beliefs on specific aspects of life, but also a global self-concept beliefs (Harter et al., 1998; Zeleke, 2004). The global self-concept (also referred to by the overlapping concepts of 'self-esteem', 'general self-concept' and 'self-worth') is defined as general satisfaction regarding oneself and a sense of personal acceptance (e.g., Zeleke, 2004).

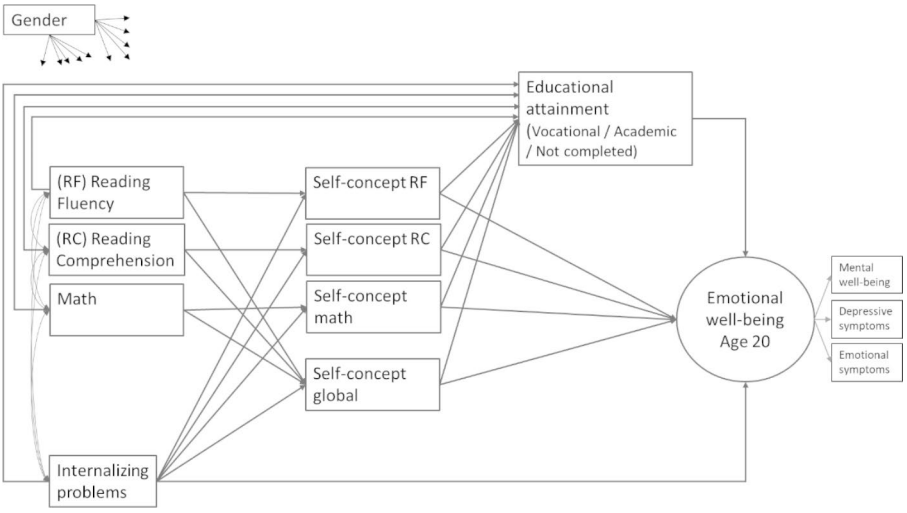

Fig. 1 The Hypothesized Model

Based on expectancy-value theory, students' interpretations of previous achievement-related experiences and feedback affect their beliefs about their academic abilities (e.g., Eccles et al., 1983; Spinath and Spinath, 2005; Wigfield et al., 2012; Wigfield and Eccles, 2000). Therefore, as students with poorer academic skills are likely to have more failure experiences and more negative feedback in school regarding their skills than students with strong academic skills, the self-concept of their ability in the academic domain is likely lower. In theory, this may lead to a negative cycle over time because beliefs about one's abilities may be reflected in learning motivation and then also in skills (Deci & Ryan, 1985; Ryan & Deci, 2000; Wigfield et al., 1998). Negative self-concept beliefs, in turn, are associated with emotional well-being, for example, anxiety (see Sowislo and Orth, 2013, for a review), and may thus mediate the association between achievement and emotional well-being. Over time, these processes may lead to a negative feedback loop, gradually causing more severe well-being problems.

Several studies have examined the association between academic skills and self-concept. However, there are mixed findings regarding the association between academic skills and global self-concept, while the association between academic skills and academic self-concept seems more robust (Bear et al., 2002; McArthur et al., 2020; Viljaranta et al., 2014; Wu et al., 2021; Zeleke, 2004). For example, some studies have shown that individuals with reading difficulties have a lower global self-concept than their peers (e.g., Alexander-Passe, 2006; Chapman and Tunmer, 1997), while others have reported no differences (e.g., Snowling et al., 2007; Taylor et al., 2010). In their recent meta-analysis, McArthur et al. (2020) reported considerable variation across studies in terms of samples, assessment methods and results. Overall, the association between poor reading and the global self-concept was significant and moderately strong; however, reading skills were more closely associated with the academic self-concept. Similarly, in the reviews by Chapman (1988) and Zeleke (2004) on self-concept beliefs among individuals with learning disabilities, the effects were moderate for the global self-concept and stronger for the academic self-concept.

We contribute to the literature by examining the McArthur et al.'s (2020) hypothesis, according to which adolescent self-concept beliefs mediate the association between reading and math skills and later emotional well-being. Therefore, in the hypothesised model (Fig. 1), Grade 9 reading fluency, reading comprehension and math skills are expected to predict emotional well-being at age 20 through academic and global self-concepts. We also include a measure of Grade 9 emotional well-being, as internalising problems, in the model. By controlling for its effect, the possible associations among achievement, self-concept beliefs and later emotional well-being is not reflecting a continuation of emotional well-being problems across age, which is shown to be common (e.g., Kim-Cohen et al., 2003; Nivard et al., 2015).

Role of educational attainment

Educational attainment, the selection of the secondary track (academic/vocational) and the completion of secondary education are included as control measures in our hypothesised model (Fig. 1). An examination of its role in this developmental period is important due to the significant associations among educational attainment, academic skills and emotional well-being. In Finland, both the content of instruction and the educational organisation of the two tracks are distinct, and the different experiences in the tracks may differentially impact students' emotional well-being. While the academic track involves studying multiple subjects (e.g., mathematics, languages, history, psychology and various STEM subjects) and requires strong academic skills, vocational education involves more focused and practical training, including practicums in workplaces. Therefore, students with learning difficulties choose the vocational track more often than the academic track (e.g., Rimkute et al., 2014). Furthermore, students with higher scores in the reading assessment of the Programme for International Student Assessment (PISA) have been reported to choose the academic track more often than those with lower scores (e.g., Burger, 2021). Learning difficulties in reading and mathematics are also associated with a higher incidence of not having completed secondary education within the expected time (e.g., Aro et al., 2019; Hakkarainen et al., 2016). In the Organisation for Economic Co-operation and Development (OECD) countries, students with low skills in literacy, numeracy and problem-solving have also been reported to be at a heightened risk of being neither employed nor in education (NEET) at age 20–24 (OECD, 2016).

Previous studies have reported that educational attainment is also associated with emotional well-being (e.g., Costello and Maughan, 2015; Erickson et al., 2016), but the results have been mixed. Hagquist (2007) reported that students on the vocational track have more psychosomatic complaints than those on the academic track. Previous studies in the Finnish context, however, have suggested that students on the academic track more often experience internalising problems (Parviainen et al., 2020) and burnout (Salmela-Aro et al., 2008; Salmela-Aro & Tynkkynen, 2012) than their peers on the vocational track. Emotional well-being problems may also be associated with dropping out of education altogether. Parviainen et al. (2020) reported that Finnish secondary school students with internalising problems had significantly higher dropout intentions than their peers with no psychological well-being problems.

Role of gender

Finally, we control for gender in the hypothesised model because it has been widely reported to be associated with both academic skills and self-reported emotional well-being. The better performance of girls in reading is a common finding across reading measures and countries (Brozo et al., 2014; Lietz, 2006; Torppa et al., 2018). In mathematics, boys are often reported to perform better (Lopez-Agudo & Ropero-Garcia, 2020; Stoet & Geary, 2013). This difference is also reflected in self-concept beliefs, as boys have a more positive self-concept for mathematics and girls for literacy (e.g., Denissen et al., 2007; Eccles et al., 1993; Wouters et al., 2013). In addition, females

report emotional well-being problems, such as anxiety and depression (Altemus et al., 2014; Bruce et al., 2005; McLean et al., 2011), as well as internalising problems (Sterba et al., 2007), more often than males.

Present study

The present study examines the predictive associations from adolescence (Grade 9, age 15–16) to young adulthood (age 20) among academic skills, self-concept beliefs and emotional well-being by investigating the fit of the hypothesised model presented in Fig. 1. Using this model, we focus on a pathway that potentially explains the associations between skills and well-being: the mediating role of self-concept between academic skills and emotional well-being (e.g., McArthur et al., 2020). Three controls are included: emotional well-being with a measure of internalising behaviour in Grade 9, educational attainment and gender. The sample comes from a longitudinal study that started to follow 200 children from birth and continued follow-up assessments until adulthood (AUTHORS). When the children entered school, their classmates were invited to participate. We previously reported from this sample the associations between skills and psychological well-being across the transition to school, from age 4 to 9 (AUTHORS) and in Grade 9 concurrently (AUTHORS). These studies suggested significant but weak associations among internalising problems (anxiety in particular), reading and math skills (AUTHORS). The current study extends this line of research to young adulthood, when educational choices for secondary school have been made and graduation is expected.

Method

Participants and procedure

This study followed 589 participants from the end of comprehensive school (Spring of Grade 9, age 15–16) until age 20. Altogether, 1,800 Finnish adolescents participated in reading fluency, reading comprehension and math skill assessments in Grade 9. During the assessments, the participants also completed questionnaires. Grade 9 data were collected in classrooms in schools located in central Finland in both urban and suburban areas. All classrooms were typical of Finnish lower secondary school classrooms. At age 20, the participants responded to the questionnaires.

Measures

Reading comprehension

Reading comprehension was assessed with PISA reading literacy items in Grade 9. The tasks used in this sample were the so-called link items used repeatedly in each cycle of the survey to ensure the comparability of the measurements. Unlike in the PISA data collection, in this sample, all participants completed the same booklet,

which contained eight different texts. The students were asked to read the texts before answering questions regarding the text. In addition to the written text, the material included tables, graphs and figures. There were 15 multiple-choice questions and 16 questions that required written responses. Of the questions, 12 required the students to access and retrieve information, 12 to integrate and interpret information and 7 to reflect on and evaluate information. The students had 60 min to complete the booklet. The score was the mean of the standardised means of the three categories (retrieve, integrate and evaluate). Cronbach's alpha reliability coefficient for the total score in this sample was 0.85.

Reading fluency

Reading fluency was assessed with three timed reading fluency tasks in Grade 9. The measure for reading fluency was the mean of the standardised scores of three group-administered tasks. Cronbach's alpha for the reading fluency composite score was 0.85.

Sentence reading The sentence reading task involved reading easy sentences (e.g., *A ball is round* or *Blueberries are yellow*) and deciding as to whether each was true by answering *yes* or *no*. The sentences were short and easy and required a minimal level of comprehension or specialised knowledge. There was a time limit of two minutes, and the score was calculated as the number of correct answers minus the number of incorrect answers.

Error search The error search task involved proofreading words written on a sheet of paper. All words had a misspelling (either a wrong letter, extra letter or missing letter). The students were asked to mark as many incorrect spellings as possible in three minutes. The score was calculated as the number of correct answers minus the number of incorrect answers.

Word chains The word chain task involved a quick identification of word boundaries. There were 25 lines on a sheet of paper, and each had four words written together without spaces in between. The students were asked to mark as many word boundaries as possible in 90 s. The score was calculated as the number of correctly found word boundaries minus the number of incorrect answers.

Math skills

Math skills were assessed using a standardised arithmetic test (Räsänen & Leino, 2005), which was intended for Grades 7 to 9 (13–16 years) and contained 40 items, yielding a maximum of 40 points. The test assessed students' performance in basic arithmetic tasks (addition, subtraction, multiplication and division), as well as in word problem-solving, algebra, geometry and unit conversion skills. This test is used

in Finland as a screening tool to identify students at risk of mathematics difficulties. Cronbach's alpha for the sum score was 0.90.

Self-concept of ability in reading fluency and comprehension

The participants were asked to evaluate their skills in comparison to same-age adolescents on three items: 'How good are you compared to your classmates in (a) reading speed, (b) reading accuracy and (c) reading comprehension?' Each item was evaluated using a scale with three answer options: 'I am better than others', 'I am as good as others' and 'I am worse than others'. For the analyses, the scales were transposed such that larger values represented a higher self-concept in reading. For the self-concept of ability in reading fluency, the items for reading speed and accuracy were combined. Cronbach's alpha for the sum score was .68. A single item was used for the self-concept of ability in reading comprehension.

Self-concept of ability in mathematics

The participants were asked to evaluate their skills in mathematics with three items: 'How good are you in math? How good are you in math compared to your classmates? How difficult are math tasks for you?' The first two items were evaluated using a 5-point Likert scale, from 1 = poor to 5 = very good, and the third item was evaluated using a 5-point Likert scale, from 1 = easy to 5 = difficult. For the analyses, the third scale was transposed such that larger values represented a higher self-concept of ability in mathematics. Cronbach's alpha reliability coefficient for the sum score was 0.91.

Global self-concept

The global self-concept was assessed in Grade 9 with a short version of Rosenberg's (1965) self-esteem scale (five items), such as *On the whole, I am satisfied with myself*; *I feel that I have a number of good qualities and at times I think I am no good at all*. The evaluation was performed on a 5-point scale (*1 = not at all true, …, 5 = very much true*). The score was the mean of the five items (two negatively worded items were reversed). Cronbach's alpha reliability coefficient for self-esteem was 0.80.

Emotional well-being: internalising problems

The students' emotional well-being was assessed using a measure of internalising problems in Grade 9. There were five items for internalising behaviour that reflected anxiety and depression: *I am worried about many things, I often feel like crying, I get tired easily, I often have a stomach-ache or headache* and *I am often unhappy or down*. The evaluation was performed on a 5-point Likert scale (*1 = not true, …, 5 = true*). The score was the mean of the items. Cronbach's alpha coefficient was 0.81.

Emotional well-being at age 20

Emotional well-being at age 20 was assessed using the three scales tapping mental well-being, depressive symptoms and emotional symptoms described below. Depressive and emotional symptoms scales were transposed such that larger values reflected a higher level of well-being. These scales were included in the models as a latent factor that had high scores, suggesting strong internal cohesion (depressive symptoms' scores indicated 1, mental well-being's scores indicated 0.87 and emotional symptoms' scores indicated 0.93). Cronbach's alpha was also high, at 0.85. Moreover, the scores were equal across gender ($\Delta\chi^2(2)=4.78$, $p>.05$).

Mental well-being Mental well-being was assessed at age 20 using the Short Warwick-Edinburgh Mental Well-being Scale (Tennant et al., 2007). This scale has seven items, such as *I've been feeling optimistic about the future, I've been feeling useful* and *I've been dealing with problems well*. The participants were asked to report their experience with each item over the previous two weeks using a 5-point Likert scale (*1=none of the time, …, 5=all of the time*). The score was the mean of the items. Cronbach's alpha coefficient was 0.89.

Depressive symptoms Depressive symptoms were assessed at age 20 with seven statements, such as *I am often sad, Other people interest me less than previously* and *I delay decision-making more than previously.* The participants were asked to evaluate the statements on a 5-point Likert scale (*1=not at all true,…, 5=very much true*). The score was the mean of the items. Cronbach's alpha coefficient was 0.89.

Emotional symptoms Emotional symptoms were assessed using the emotional symptoms scale from the Strengths and Difficulties Questionnaire (Goodman, 1997, 2001). This scale has five items, such as *I worry a lot, I am nervous in new situations, I easily lose confidence, I have many fears, and I am easily scared.* The participants were asked to evaluate the statements using a 5-point Likert scale (*1=not at all true, …, 5=very much true*). The score was the mean of the items. Cronbach's alpha coefficient was 0.77.

Educational attainment

The participants were asked to report their highest completed educational level. The response options were comprehensive school (n=51, 8.7%), vocational school (n=166, 28.3%) and high school (n=363, 61.9%). Information was missing for six participants. As the expected completion age of vocational school and high school in Finland is 18–19 years (depending on the birth month), the participants who responded 'comprehensive school' had likely either dropped out or were delayed in completing their secondary-level education. The educational track measure was dummy-coded

to examine the differences between each pair of the three tracks (non-completers, vocational and academic), resulting in three variables, one for each contrast.

Statistical analysis

Data analysis began by examining the missing values and distributions. The distributions of all measures except for internalising problems in Grade 9 and emotional problems and depressive symptoms at age 20 were close to normal (all with some floor effect). However, according to the strict normality tests of Kolmogorov–Smirnov and Shapiro–Wilk, only reading fluency was normally distributed. Despite some floor effects, the problems in distributions were not severe, as suggested by the skewness and kurtosis values below. In addition, there were no extreme outliers in any of the measures (more than three standard deviations from the mean). Because of the non-normality of the distributions, the model parameters were estimated using a maximum likelihood estimation with robust standard errors, which is considered robust to non-normality (Muthén & Muthén, 1998–2012). Due to attrition, analyses comparing the participants with and without data at age 20 in terms of means, variances and associations among the Grade 9 measures were conducted before estimating the path models.

In the hypothesised model, all measures were regressed on gender (to increase figure clarity, the associations are depicted as short arrows from the gender variable). In Grade 9, emotional well-being was assessed by internalising problems and their impact on self-concept measures; educational track and emotional well-being were controlled for. The correlations among the skills and internalising problems and the residual correlations among the self-concept variables were included in the model (estimates in Table 4). Educational attainment was included as a dummy-coded variable to examine their paired differences in age-20 emotional well-being and all Grade 9 measures and gender. Therefore, three path models were reported, one for each educational attainment contrast: Model 1 compared the vocational and academic tracks (Fig. 2), Model 2 compared the vocational track and the group that had not completed secondary education (Fig. 3) and Model 3 compared the academic track and the no-completion group (Fig. 4).

Before the analyses, we also tested if gender moderates the model estimates by running multigroup models and comparing the fit of the models in which all estimates were estimated freely for both genders and a model in which all estimates were fixed equal. No gender differences were found. First, the loadings for the emotional well-being latent factor were equal for boys and girls ($\Delta\chi^2(2)=4.78$, $p=.09$). Second, all estimates were equal for boys and girls in the hypothesised models contrasting vocational and academic educational attainment ($\Delta\chi^2(25)=30.47$, $p=.21$), in the model contrasting vocational educational attainment and non-completers ($\Delta\chi^2(25)=33.50$, $p=.12$) and in the model contrasting academic educational attainment and non-completers ($\Delta\chi^2(25)=29.48$, $p=.24$).

The goodness-of-fit of the estimated models was evaluated using the χ^2-test, the comparative fit index (CFI), the root mean square error of approximation (RMSEA) and the standardised root mean square residual (SRMR). Good model fit was indicated by a small, preferably non-significant χ^2, CFI > 0.95, RMSEA < 0.06 and

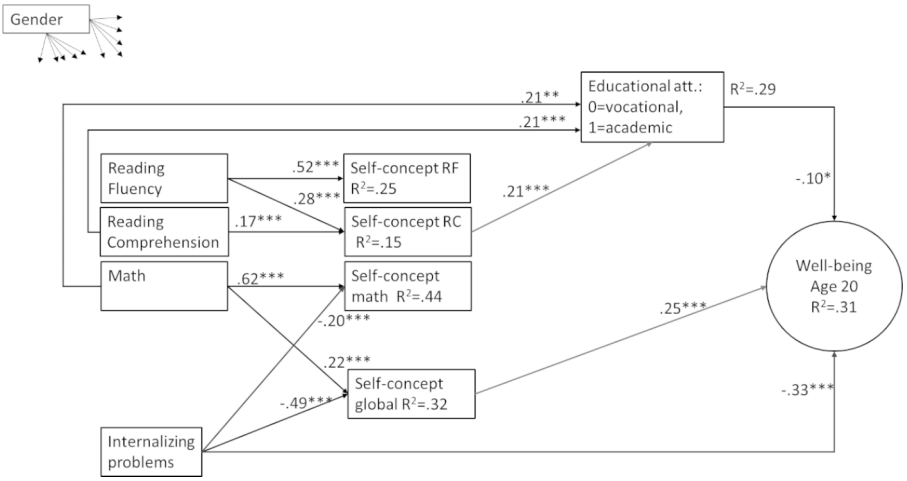

Fig. 2 The Path Model 1 with the Contrast between Vocational and Academic Educational Attainment

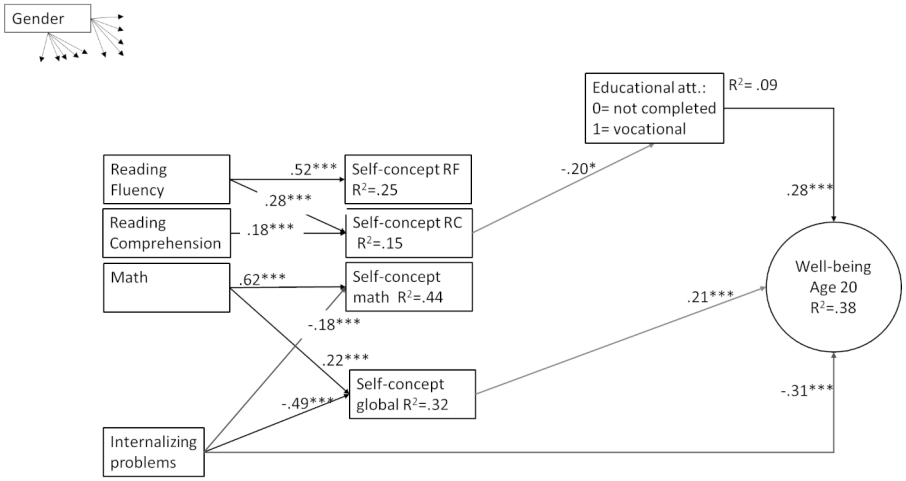

Fig. 3 The Path Model 2 with the Contrast between Non-Completers and Vocational Educational Attainment

SRMR < 0.08 (Hu & Bentler, 1999). Mplus 8.7 (Muthén & Muthén, 1998–2012) was used in modelling.

Missing values and attrition analysis

In the full Grade 9 sample, there were 1,788 participants (51% girls); of them, 586 (33%, 61% girls) were contacted at age 20. The reason for the large number of missing values is a combination of a lack of response and not being able to locate the former participants. Little's MCAR test suggested that the missing values were not

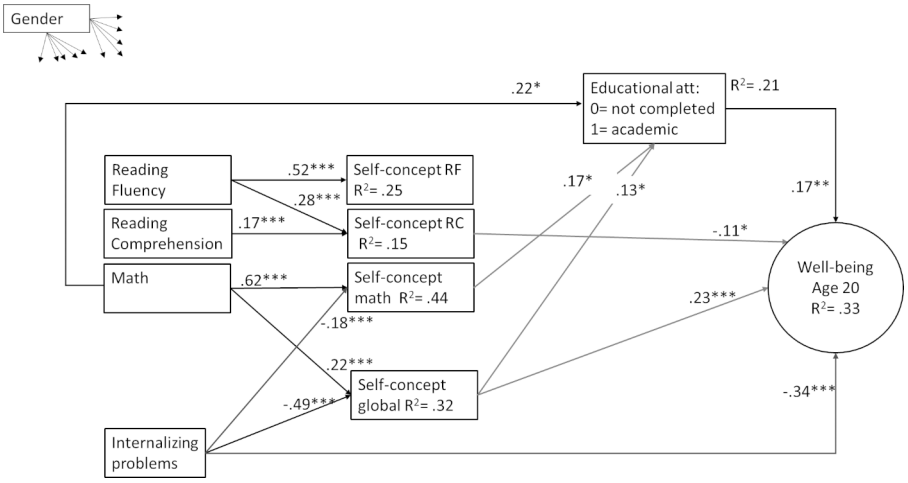

Fig. 4 The Path Model 3 with the Contrast between Non-Completers and Academic Educational Attainment

Table 1 Differences in the Standardized Grade 9 Measures between the Participants Who Did or Did Not Participate at Age 20

	Participated at age 15 only			Participated at age 15 and 20				
	N	Mean	SD	N	Mean	SD	F (df)	Cohen d
Reading comprehension	865	-0.08	0.88	462	0.12	0.82	15.58***	0.23
Reading fluency	1215	-0.09	0.87	585	0.15	0.81	30.74***	0.28
Math	1072	-0.10	1.01	557	0.18	0.95	30.69***	0.29
Self-concept: reading fluency	1087	-0.03	0.99	521	0.06	1.02	2.61	0.09
Self-concept: reading comprehension	1086	-0.05	0.98	520	0.11	1.04	8.54**	0.15
Self-concept: math	1090	-0.08	1.01	524	0.17	0.95	23.42***	0.26
Self-concept: global	1081	-0.02	1.01	518	0.03	0.98	0.79	0.05
Internalizing problems	1071	-0.02	1.01	518	0.05	0.98	1.94	0.07

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

missing completely randomly: $\chi^2(116)=282.436$, $p<.001$. To understand the potential impact of attrition on the results, we compared the Grade 9 measures between the participating and non-participating participants (Table 1). The results suggested that the sample participating at age 20 was diluted from the poorer performing end of the skill assessments to the self-concept belief distributions. The effect sizes were small to negligible, but the fact that the sample participating at age 20 was somewhat skewed towards academically better-performing adolescents needs to be acknowledged in the interpretation of the findings.

There were also some missing values in all measures for the sample of the 586 participants followed until age 20. Little's MCAR test suggested that these missing values were missing completely randomly: $\chi^2(132)=140.184$, $p=.297$.

Results

Descriptive statistics and gender differences

Table 2 presents the means, standard deviations and gender comparisons. In Grade 9, the female participants were better readers and had a higher reading comprehension self-concept but reported more internalising problems and lower self-esteem than the males. The male participants scored higher on the math task and had a higher self-concept in math. At age 20, the women reported more depression and emotional problems and lower mental well-being. The effect sizes were small to medium, except for the internalising problems, which showed a large effect size. Because of the significant differences, gender was included in the models as a control variable.

The correlation coefficients are presented in Table 3. Significant associations were found at both assessment times. In addition, there were significant correlations between the age-20 measures and Grade 9 internalising problems, global self-concept and math self-concept.

Path models predicting age-20 well-being with grade 9 skills

Three models testing the hypothesised model were estimated to examine all contrasts among the three educational attainment categories separately (Table 4). Figure 2 illustrates Model 1, contrasting vocational and academic educational attainment. Figure 3 illustrates Model 2, contrasting vocational and non-completers. Figure 4 illustrates Model 3, contrasting vocational and non-completers. The models fit the data well: Model 1, $\chi^2(28)=60.63$, $p<.001$, RMSEA=0.05 (0.03–0.06), CFI=0.98, SRMR=0.02; Model 2, $\chi^2(28)=64.54$, $p<.001$, RMSEA=0.05 (0.03–0.06), CFI=0.98, SRMR=0.03 and Model 3, $\chi^2(28)=67.15$, $p<.001$, RMSEA=0.05 (0.03–0.06), CFI=0.98, SRMR=0.03.

The models indicate that academic skills directly predict self-concept beliefs and educational attainment. First, there were significant positive associations between each skill and its respective self-concept of ability. In addition, better reading fluency was associated with a higher reading comprehension self-concept. Second, the global self-concept was significantly associated with math skills but not with reading fluency or comprehension. The better the math skills, the higher the global self-concept. Third, better reading comprehension and math skills predicted completion of the academic educational track. In particular, the participants who graduated from the academic track had, on average, better performance in the PISA reading and math tests than those who graduated from vocational education (Model 1). Furthermore, Model 3 indicated that the participants who graduated from the academic track, on average, performed better on the math test than the non-completers. There were no differences between the vocational educational attainment and non-completers in terms of any of the Grade 9 skills.

The models further indicate that of the self-concept beliefs, global self-concept, in particular, predicted age-20 emotional well-being (4–6% of the variance). In addition, a small significant negative path (-0.11) from the reading comprehension self-concept to age-20 well-being was identified, but only in the Model 3 that contrasted

Table 2 Descriptive Statistics and Gender Comparisons For all Measures

	Female		Male			
	M	sd	M	sd	F	Cohen d
Age 15						
Reading comprehension (z)	0.28	0.69	-0.11	0.93	26.73***	−0.48
Reading fluency (z)	0.32	0.77	-0.11	0.82	41.22***	−0.54
Math	23.69	6.76	25.80	6.46	13.34***	0.32
Self-concept: reading comprehension	1.97	0.49	1.87	0.52	4.54*	−0.19
Self-concept: reading fluency	1.97	0.46	1.98	0.40	0.13	0.03
Self-concept; math	3.22	0.94	3.56	0.98	15.57***	0.36
Self-concept; global	3.23	0.73	3.62	0.71	34.99***	0.54
Internalizing problems	2.71	0.80	2.02	0.76	93.36***	−0.89
Age 20						
Mental well-being	3.69	0.62	3.87	0.63	9.75**	0.29
Depression	2.11	0.88	1.86	0.79	10.25**	−0.30
Emotional problems	3.75	2.40	2.31	2.06	54.45***	−0.64

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

z = mean of standardized scores based on a sample of 1358 students for reading comprehension and 1834 students for reading fluency

Table 3 Correlation Coefficients (Pearson) between the Measures

	1	2	3	4	5	6	7	8	9	10
Grade 9 measures										
1. Reading comprehension										
2. Reading fluency	0.39***									
3. Math	0.46***	0.41***								
4. Self-concept: reading comp.	−0.28***	−0.27***	−0.22***							
5. Self-concept: reading flu.	−0.23***	−0.47***	−0.23***	0.53***						
6. Self-concept: math	0.33***	0.15**	0.62***	−0.27***	−0.18***					
7. Self-concept: global	−0.06	−0.03	0.25***	−0.20***	−0.15**	0.33***				
8. Internalizing problems	0.05	0.13**	−0.06	0.08	0.02	−0.23***	−0.52***			
Age 20 measures										
9. Mental well-being	0.01	0.01	0.08	−0.09	−0.08	0.19***	0.37***	−0.36***		
10. Depression	0.02	0.06	−0.06	−0.02	−0.03	−0.15**	−0.36***	0.39***	−0.67***	
11. Emotional problems	0.12*	0.06	−0.07	−0.02	0.04	−0.18***	−0.38***	0.46***	−0.60***	0.70***

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

academic educational attainment and non-completers. This suggests that those with a higher reading comprehension self-concept had somewhat lower well-being at age 20. As the correlation coefficient between the reading comprehension self-concept and age-20 well-being indicators was not significant, this association is likely a spurious correlation that should be interpreted with caution.

Furthermore, self-concept beliefs predicted educational attainment in all models. The global self-concept predicted educational attainment in Model 3, suggesting that students who had not completed secondary education by age 20 had a lower global self-concept in Grade 9 than those who had graduated from the academic track. In addition, the reading comprehension self-concept predicted educational attainment in Models 1 and 2, suggesting lower reading comprehension among the vocational track completers than the other participants. Math self-concept was a significant predictor of educational attainment in Model 3, suggesting better math self-concept among those who had graduated from the academic track than among those who had not completed secondary education.

Of the control measures, internalising problems and educational attainment also had significant direct effects on emotional well-being. First, Grade 9 internalising problems predicted 22% of age-20 well-being, suggesting stability in the emotional well-being problems from adolescence to young adulthood. Second, educational attainment explained 1–8% of age-20 well-being, depending on the model. Both the vocational and academic educational attainment groups had higher well-being than the non-completers. Furthermore, the vocational educational attainment group had a higher level of emotional well-being than the academic educational attainment group. Internalising problems were also associated with poorer global self-concepts and lower self-concepts in math but not with lower reading self-concepts.

Finally, there were some significant indirect effects predicting age-20 emotional well-being (Table 5). First, in all models, there was a statistically significant indirect path from math skill to age-20 emotional well-being via the global self-concept. The positive effect suggests that the better the math skills, the higher the self-esteem and, further, the higher the well-being five years later. Second, in Model 2, there were statistically significant indirect paths from reading fluency and comprehension to age-20 well-being via reading comprehension self-concept and educational attainment. This pathway suggests that better reading skills predicted higher emotional well-being via better reading comprehension self-concept for those who completed vocational education, in contrast to non-completers. Third, in Model 3, there were statistically significant indirect paths from reading fluency and comprehension to age-20 well-being via the reading comprehension self-concept. Fourth, the effect of internalising problems on emotional well-being ran partially via the global self-concept. Finally, there were various small indirect effects from gender on emotional well-being via skills, internalising problems, the global self-concept and the reading comprehension self-concept.

Discussion

The present study examined the associations between reading and math skills and emotional well-being in a Finnish sample from adolescence to age 20. We tested a hypothesised model where the predictive impact of reading fluency, reading comprehension and math skills on emotional well-being was mediated via self-concept beliefs (skill-specific and global) and educational attainment. Gender and adolescents' Grade 9 emotional well-being (internalising problems) were controlled. The results suggested no direct associations between adolescents' reading and math skills and their age-20 emotional well-being. There were also no significant differences in emotional well-being between adolescents with and without reading and/or math difficulties. However, indirect effects on emotional well-being were found for reading skills via reading comprehension self-concept and educational attainment, as well as for math skills via global self-concept.

Our findings of no direct predictive associations between skills and emotional well-being concur with those of some previous studies (Carroll et al., 2005; Parhiala et al., 2015). The findings differ, however, from many other studies suggesting an association (e.g., Francis et al., 2019). For example, Aro et al. (2019, 2022, 2023) reported that, in a Finnish clinical sample, adults with a childhood diagnosis of learning difficulty had poorer mental health than their peers without learning difficulties. These findings suggest that the association between skills and emotional well-being is not found in a general school sample but can be stronger when the difficulties are more severe. Furthermore, the strongest associations between dyslexia and emotional well-being measures have been found for anxiety (e.g., Francis et al., 2019), which was not examined in this study.

Although adolescent academic skills did not directly predict age-20 emotional well-being, indirect associations via self-concept beliefs were found. In line with previous studies (Chapman, 1988; McArthur et al., 2020; Zeleke, 2004), skill-specific self-concept beliefs were closely associated with their respective reading and math skills, suggesting that adolescents are well aware of their academic skills in each domain. However, similar to the actual skills, the skill-specific self-perceptions were not strongly associated with emotional well-being five years later. In contrast, the Grade 9 global self-concept was significantly associated with well-being, both concurrently (internalising problems) and as a predictor of age-20 emotional well-being. However, there was also a negative association between math skills and the global self-concept, suggesting that poorer math skills make individuals vulnerable to more negative views of themselves in general and not just in the math domain. This finding supports those of previous studies linking learning difficulties with a more negative global self-concept (e.g., Undheim and Sund, 2008). In contrast, no association was found between reading skills and the global self-concept. This finding contradicts a recent review (McArthur et al., 2020; see also Chapman, 1988; Zeleke, 2004) that found a moderate association between global self-concept and reading. Our results might be affected by the fact that poorer readers responded less often to the age-20 questionnaire than better readers. Possibly, a significant effect could have been found if more of the poorer readers were included in the sample. However, it is also possible that the combination of the educational context and the nature of the Finnish orthog-

Table 4 Standardized Estimates for the Path Models 1–3

	Model 1 (Educational attainment: 0 = vocational, 1 = academic)	Model 2 (Educational attainment: 0 = not completed, 1 = vocational)	Model 3 (Educational attainment: 0 = not completed, 1 = academic)
Path estimates			
SC_RF→Well-being	0.04	0.04	0.04
SC_RC→Well-being	−0.09	−0.04	−0.11*
SC_Math→Well-being	0.09	0.03	0.00
SC_Global→Well-being	0.25***	0.21***	0.23***
Educ.att. →Well-being	−0.10*	0.28***	0.17**
Intern.→Well-being	−0.33***	−0.31***	−0.34***
Gender→Well-being	0.04	0.09	0.08
RF→ Educ. att.	0.04	−0.01	0.01
RC→ Educ. att.	0.21***	−0.09	0.05
Math→ Educ. att.	0.21**	0.05	0.22*
SC_RF→ Educ.att.	−0.03	0.02	−0.02
SC_RC→ Educ.att.	0.21***	−0.20*	0.05
SC_Math→ Educ.att.	0.11	0.10	0.17*
SC_Global→ Educ.att.	0.00	−0.14	0.13*
Intern.→ Educ. att.	0.02	−0.12	−0.05
Gender→Educ.att.	−0.09	−0.16	−0.15**
RF→SC_RF	0.52***	0.52***	0.52***
Intern.→SC_RF	−0.05	−0.05	−0.05
Gender→SC_RF	0.12**	0.11***	0.11**
RF→SC_RC	0.28***	0.28***	0.28***
RC→SC_RC	0.17***	0.18***	0.17***
Intern.→SC_RC	−0.05	−0.05	−0.05
Gender→SC_RC	0.20***	0.20***	0.20***
Math→SC_Math	0.62***	0.62***	0.62***
Intern. →SC_Math	−0.20***	−0.18***	−0.18***
Gender→SC_Math	0.02	0.02	0.02
RF→SC_Global	0.06	0.06	0.06
RC→SC_Global	−0.05	−0.05	−0.05
Math→SC_Global	0.22***	0.22***	0.22***
Intern.→SC_Global	−0.49***	−0.49***	−0.49***
Gender→SC_Global	0.03	0.04	0.03
Gender→RF	−0.26***	−0.26***	−0.26***
Gender→RC	−0.24***	−0.24***	−0.24***
Gender→Math	0.16***	0.16***	0.16***
Gender→Intern.	−0.40***	−0.40***	−0.40***
Correlations			
RF with RC	0.36***	0.36***	0.36***
RF with Math	0.47***	0.47***	0.46***
RC with Math	0.52***	0.53***	0.53***
RF with Intern.	0.02	0.02	0.02
RC with Intern.	−0.06	−0.06	−0.06
Math with Intern.	−0.03	−0.02	−0.02

Table 4 (continued)

	Model 1 (Educational attainment: 0 = vocational, 1 = academic)	Model 2 (Educational attainment: 0 = not completed, 1 = vocational)	Model 3 (Educational attainment: 0 = not completed, 1 = academic)
Residual correlations			
SC_RF with SC_RC	0.46***	0.46***	0.46***
SC_RF with SC_Math	0.10*	0.10*	0.10
SC_RF with SC_Global	0.11*	0.11*	0.11
SC_RC with SC_Math	0.20***	0.20***	0.20***
SC_RC with SC_Global	0.15**	0.15**	0.15**
SC_Math with SC_Global	0.14***	0.14***	0.14***

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

SC_RF = self-concept in reading fluency, SC_RC = self-concept in reading comprehension, SC_Math = self-concept in math, RC = reading comprehension, RF = Reading fluency, Intern. = internalizing problems, Educ.att.=educational attainment dummy variable

Table 5 The Significant Standardized Indirect Effects on Age 20 Emotional Well-being in the Three Models

	Model 1 (Educational attainment: 0 = vocational, 1 = academic)	Model 2 (Educational attainment: 0 = not completed, 1 = vocational)	Model 3 (Educational attainment: 0 = not completed, 1 = academic)
Math→ SC_Global→	0.06**	0.05**	0.05**
RC→SC_RC→Educ. att→	-	0.01*	-
RC→SC_RC→	-	-	−0.02*
RF→SC_RC→Educ. att→	-	0.02*	-
RF→SC_RC→	-	-	−0.03*
Intern.→SC_Global→	0.12***	0.10***	0.11***
Gender→Intern.→	0.12***	0.13***	0.13***
Gender→ Educ. att→	-	-	−0.03*
Gender→RF→ SC_RC→	-	-	0.01*
Gender→Math→SC_Global→	0.01*	0.01*	0.01*
Gender→Intern.→ SC_Global→	0.04***	0.05***	0.04***
Gender→ SC_RC→ Educ. att→	−0.01*	-	-

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

SC_RF = self-concept in reading fluency, SC_RC = self-concept in reading comprehension, SC_Math = self-concept in math, RC = reading comprehension, RF = Reading fluency, Intern. = internalizing problems, Educ.att.=educational attainment dummy variable

raphy, which makes learning to read a relatively quick and easy process for most children (e.g., Seymour et al., 2003), provides a context in which reading difficulties' impact on the global self-concept is weaker than that in some other contexts. Future studies are needed to better understand how writing systems, educational systems and cultures more generally affect the associations among reading skills, self-concept beliefs and emotional well-being.

The results also suggest that educational attainment (track selection and completion of the vocational/academic track in the expected time) is associated with age-20

emotional well-being. The participants who had not yet completed secondary education had lower emotional well-being than those who had completed either vocational or academic education. As emotional well-being and completion of secondary education were both assessed simultaneously, the direction of a causal relationship cannot be discerned, as effects in both directions are possible. Interestingly, track selection (academic versus vocational) was also associated with age-20 emotional well-being. Similar to other recent studies using different Finnish samples (Parviainen et al., 2020; Salmela-Aro et al., 2008; Salmela-Aro & Tynkkynen, 2012), the academic track students in our sample reported poorer well-being than their peers on the vocational track. This is a potentially interesting finding from the viewpoint of the lacking association between adolescent skills and age-20 emotional well-being. The vocational track selection might have protected the participants with poorer skills from stress and emotional distress, as, in line with previous studies, the students with poorer skills more often chose the vocational track (e.g., Burger, 2021; Falter, 2012; Rimkute et al., 2014).

Overall, the models could predict about one-third of the variance in age-20 emotional well-being, with the control measures (educational attainment, gender and Grade 9 internalising problems) playing a significant role. Grade 9 internalising problems were a significant risk factor for poorer emotional well-being in young adulthood, supporting previous research on the continuation of emotional problems across time (e.g., Akingbuwa et al., 2020; Kim-Cohen et al., 2003; Rao and Chen, 2009). Such findings suggest that it is important to find effective support for students with problems in emotional well-being while they are still at school, where it is possible to reach them. Early support is likely more effective than later support, as problems tend to accumulate and increase in severity over time.

The current study has several limitations that future studies should address. First, although the study used a longitudinal sample followed over five years, it does not allow causal conclusions. Many of the processes linking emotional well-being and academic achievement may have started years before the first assessment in adolescence. For example, the associations between academic skills and self-concept beliefs may have developed reciprocally over several years prior to adolescence (e.g., Marsh et al., 2005; Valentine et al., 2004). However, the effect of skills on self-concept seems to be stronger than the other way around. Viljaranta et al. (2014), for example, examined the development of reading and math skills, self-concept of ability in reading and math and interest in reading and math across Grades 2–7 in a Finnish sample. They found that reading and math skills predicted subsequent self-concept of ability but not vice versa and that the effects of skills on self-concept were mediated through interest in reading/math. As longitudinal studies with repeated assessments from early on in this area are rare, further research in this area is required to better understand the developmental pathways linking self-concept beliefs, skills and motivation. Second, various factors known to affect emotional well-being were not included in this study, and the study cannot offer a full explanation of the reasons underlying emotional well-being at age 20. However, almost one-third of the individual variability in emotional well-being was explained by the measures included. Third, the sample was diluted from the lower end of the skill distribution due to attrition. This likely affected

our results, in that the associations between skills and well-being were weaker than those observed in some other studies. In general, the associations seem to be stronger in clinical samples than in population-based samples. Despite this shortcoming, this study reveals the long-term associations during an important developmental period and the indirect effects on emotional well-being through the educational track and self-concept beliefs for mathematics. Finally, the self-concept measures were based on a limited set of questions, which prevented the use of latent factors and may have affected measurement reliability. Future studies should seek to strengthen the reliability of self-perception measures.

In conclusion, the results suggest that young adults' well-being is jointly determined by various risk and protective factors rather than being directly linked or etiologically comorbid with reading and math difficulties. However, reading comprehension and math skills seem to play a role in emotional well-being through self-concept beliefs and educational attainment. Future studies should examine when and by which mechanisms the association between global self-concept and math skills, in particular, emerges. Based on this study, we cannot specify the developmental origins of these associations; a longitudinal study starting earlier and repeatedly assessing the key measures is required. If learning difficulties and the global perception of self-worth start to intertwine through school experiences of failure and feedback, we need to find ways to change learning environments. Overall, the results suggest that adolescent self-concept beliefs, particularly the global self-concept, should receive careful attention. Adolescents with math difficulties who develop generalised negative self-perceptions may be at risk for poorer emotional well-being as young adults.

Funding Open Access funding provided by University of Jyväskylä (JYU). The data collection was funded by several grants over the years from the Academy of Finland. The present study is part of the CRITICAL Consortium funded by the Strategic Research Council (SRC) established within the Academy of Finland (Grants 335625 for Kristian Kiili and 335727 for Minna Torppa). The first author was funded by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No. 101002966).

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by/4.0/.

References

Akingbuwa, W. A., Hammerschlag, A. R., Jami, E. S., Allegrini, A. G., Karhunen, V., Sallis, H., & Middeldorp, C. M. (2020). Genetic associations between childhood psychopathology and adult depression and associated traits in 42 998 individuals: A meta-analysis. *JAMA Psychiatry*, *77*(7), 715–728. https://doi.org/10.1001/jamapsychiatry.2020.0527.

Alexander-Passe, N. (2006). How dyslexic teenagers cope: An investigation of self-esteem, coping and depression. *Dyslexia*, *12*(4), 256–275. https://doi.org/10.1002/dys.318.

Altemus, M., Sarvaiya, N., & Epperson, C. N. (2014). Sex differences in anxiety and depression clinical perspectives. *Frontiers in Neuroendocrinology*, *35*(3), 320–330. https://doi.org/10.1016/j.yfrne.2014.05.004.

Aro, T., Eklund, K., Eloranta, A. K., Närhi, V., Korhonen, E., & Ahonen, T. (2019). Associations between childhood learning disabilities and adult-age mental health problems, lack of education, and unemployment. *Journal of Learning Disabilities*, *52*(1), 71–83. https://doi.org/10.1177/0022219418775118.

Aro, T., Eklund, K., Eloranta, A. K., Ahonen, T., & Rescorla, L. (2022). Learning disabilities elevate children's risk for behavioral-emotional problems: Differences between LD types, genders, and contexts. *Journal of Learning Disabilities*, *55*(6), 465–481. https://doi.org/10.1177/00222194211056297.

Aro, T., Neittaanmäki, R., Korhonen, E., Riihimäki, H., & Torppa, M. (2023). A register study shows both homotypic and heterotypic comorbidity among individuals with learning disabilities. *Journal of Learning Disabilities*. https://doi.org/10.1177/00222194221150230.

Auerbach, J. G., Gross-Tsur, V., Manor, O., & Shalev, R. S. (2008). Emotional and behavioral characteristics over a six-year period in youths with persistent and nonpersistent dyscalculia. *Journal of Learning Disabilities*, *41*(3), 263–273. https://doi.org/10.1177/0022219408315637.

Bear, G. G., Minke, K. M., & Manning, M. A. (2002). Self-concept of students with learning disabilities: A meta-analysis. *School Psychology Review*, *31*(3), 405. https://doi.org/10.1080/02796015.2002.12086165.

Brozo, W. G., Sulkunen, S., Shiel, G., Garbe, C., Pandian, A., & Valtin, R. (2014). Reading, gender, and engagement: Lessons from five PISA countries. *Journal of Adolescent & Adult Literacy*, *57*(7), 584–593. https://doi.org/10.1002/jaal.291.

Bruce, S. E., Yonkers, K. A., Otto, M. W., Eisen, J. L., Weisberg, R. B., Pagano, M., & Keller, M. B. (2005). Influence of psychiatric comorbidity on recovery and recurrence in generalized anxiety disorder, social phobia, and panic disorder: A 12-year prospective study. *American Journal of Psychiatry*, *162*(6), 1179–1187. https://doi.org/10.1176/appi.ajp.162.6.1179.

Burger, K. (2021). Human agency in educational trajectories: Evidence from a stratified system. *European Sociological Review*, *37*(6), 952–971. https://doi.org/10.1093/esr/jcab021.

Carroll, J., & Iles, J. (2006). An assessment of anxiety levels in dyslexic students in higher education. *British Journal of Educational Psychology*, *76*, 651–662. https://doi.org/10.1348/000709905X66233.

Carroll, J. M., Maughan, B., Goodman, R., & Meltzer, H. (2005). Literacy difficulties and psychiatric disorders: Evidence for comorbidity. *Journal of Child Psychology and Psychiatry*, *46*(5), 524–532. https://doi.org/10.1111/j.1469-7610.2004.00366.x.

Chapman, J. W. (1988). Learning disabled children's self-concepts. *Review of Educational Research*, *58*(3), 347–371. https://doi.org/10.3102/00346543058003 3.

Chapman, J. W., & Tunmer, W. E. (1997). A longitudinal study of beginning reading achievement and reading self-concept. *British Journal of Educational Psychology*, *67*(3), 279–291. https://doi.org/10.1111/j.2044-8279.1997.tb01244.x.

Cicchetti, D., & Toth, S. L. (1991). A developmental perspective on internalizing and externalizing disorders. *Internalizing and externalizing expressions of dysfunction*. D. Cicchetti, S.L. Toth (Eds.), Rochester symposium on developmental psychopathology: Internalizing and externalizing expressions of dysfunction, Vol. 2, Erlbaum, Hillsdale, NJ (1991), pp. 1–20

Costello, E. J., & Maughan, B. (2015). Annual research review: Optimal outcomes of child and adolescent mental illness. *Journal of Child Psychology and Psychiatry*, *56*(3), 324–341. https://doi.org/10.1111/jcpp.12371.

Davis, T., Nida, R., Zlomke, K., & Nebel-Schwalm, M. (2009). Health-related quality of life in college undergraduates with learning disabilities: The mediational roles of anxiety and sadness. *Journal of Psychopathology and Behavioral Assessment*, *31*, 228–234. https://doi.org/10.1007/s10862-008-9110-4.

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

Denissen, J. J. A., Zarrett, N. R., & Eccles, J. S. (2007). I like to do it, I'm able, and I know I am: Longitudinal couplings between domain-specific achievement, self-concept, and interest. *Child Development*, *78*, 430–447. https://doi.org/10.1111/j.1467-8624.2007.01007.x.

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

Eccles, J. S., Wigfield, A., Harold, R., & Blumenfeld, P. (1993). Age and gender differences in children's self- and task perceptions during elementary school. *Child Development*, *64*, 830–847. https://doi.org/10.2307/1131221.

Erickson, J., El-Gabalawy, R., Palitsky, D., Patten, S., Mackenzie, C. S., Stein, M. B., & Sareen, J. (2016). Educational attainment as a protective factor for psychiatric disorders: Findings from a nationally representative longitudinal study. *Depression and Anxiety*, *33*(11), 1013–1022. https://doi.org/10.1002/da.22515.

Falter, J. M. (2012). Parental background, upper secondary transitions and schooling inequality in Switzerland. *Swiss Journal of Sociology*, *38*(2).

Francis, D. A., Caruana, N., Hudson, J. L., & McArthur, G. M. (2019). The association between poor reading and internalizing problems: A systematic review and meta-analysis. *Clinical Psychology Review*, *67*, 45–60. https://doi.org/10.1016/j.cpr.2018.09.002.

Goodman, R. (1997). The Strengths and Difficulties Questionnaire: A Research note. *Journal of Child Psychology and Psychiatry*, *38*(5), 581–586. https://doi.org/10.1111/j.1469-7610.1997.tb01545.x.

Goodman, R. (2001). Psychometric Properties of the Strengths and Difficulties Questionnaire. *American Academic Child Adolescence Psychiatry*, *40*(11), 1337–1345. https://doi.org/10.1097/00004583-200111000-00015.

Hagquist, C. E. (2007). Health inequalities among adolescents—the impact of academic orientation and parents' education. *The European Journal of Public Health*, *17*(1), 21–26. https://doi.org/10.1093/eurpub/ckl087.

Hakkarainen, A. M., Holopainen, L. K., & Savolainen, H. K. (2016). The impact of learning difficulties and socioemotional and behavioural problems on transition to postsecondary education or work life in Finland: A five-year follow-up study. *European Journal of Special Needs Education*, *31*(2), 171–186. https://doi.org/10.1080/08856257.2015.1125688.

Harter, S., Whitesell, N. R., & Junkin, L. J. (1998). Similarities and differences in domain-specific and global self-evaluations of learning-disabled, behaviorally disordered, and normally achieving adolescents. *American Educational Research Journal*, *35*(4), 653–680. https://doi.org/10.3102/00028312035004653.

Hinshaw, S. P. (1992). Externalizing behavior problems and academic underachievement in childhood and adolescence: Causal relationships and underlying mechanisms. *Psychological Bulletin*, *111*(1), 127–155. https://doi.org/10.1037/0033-2909.111.1.127.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1–55. https://doi.org/10.1080/10705519909540118.

Kim-Cohen, J., Caspi, A., Moffitt, T. E., Harrington, H., Milne, B. J., & Poulton, R. (2003). Prior juvenile diagnoses in adults with mental disorder: Developmental follow-back of a prospective-longitudinal cohort. *Archives of General Psychiatry*, *60*(7), 709–717. https://doi.org/10.1001/archpsyc.60.7.709.

Klassen, R., Tze, V., & Hannok, W. (2013). Internalizing problems of adults with learning disabilities: A meta-analysis. *Journal of Learning Disabilities*, *46*, 317–327. https://doi.org/10.1177/0022219411422260.

Lietz, P. (2006). A meta-analysis of gender differences in reading achievement at the secondary school level. *Studies in Educational Evaluation*, *32*(4), 317–344. https://doi.org/10.1016/j.stueduc.2006.10.002.

Lopez-Agudo, L. A.and, & Ropero-Garcia, M. A. (2020). Out-of-school use of time and its association with gender differences in educational outcomes. *Child Indicators Research*, *13*(4), 1335–1369. https://doi.org/10.1007/s12187-019-09701-y.

Marsh, H. W., & Shavelson, R. (1985). Self-concept: Its multifaceted, hierarchical structure. *Educational Psychologist*, *20*(3), 107–123. https://doi.org/10.1207/s15326985ep2003_1.

Marsh, H. W., Trautwein, U., Lüdtke, O., Köller, O., & Baumert, J. (2005). Academic self-concept, interest, grades, and standardized test scores: Reciprocal effects models of causal ordering. *Child Development*, *76*(2), 397–416. https://doi.org/10.1111/j.1467-8624.2005.00853.x.

McArthur, G. M., Filardi, N., Francis, D. A., Boyes, M. E., & Badcock, N. A. (2020). Self-concept in poor readers: A systematic review and meta-analysis. *PeerJ*, *8*, e8772. https://doi.org/10.7717/peerj.8772.

McLean, C. P., Asnaani, A., Litz, B. T., & Hofmann, S. G. (2011). Gender differences in anxiety disorders: Prevalence, course of illness, comorbidity and burden of illness. *Journal of Psychiatric Research*, *45*(8), 1027–1035. https://doi.org/10.1016/j.jpsychires.2011.03.006.

Muthén, L. K., & Muthén, B. O. (1998–2012). *Mplus user's guide* (7th ed.). Los Angeles, CA: Muthén & Muthén.

Nelson, J. M., Lindstrom, W., & Foels, P. A. (2015). Test anxiety among college students with specific reading disability (dyslexia) nonverbal ability and working memory as predictors. *Journal of Learning Disabilities*, *48*(4), 422–432. https://doi.org/10.1177/00222194135076.

Nivard, M. G., Dolan, C. V., Kendler, K. S., Kan, K. J., Willemsen, G., Van Beijsterveldt, C. E. M., & Boomsma, D. I. (2015). Stability in symptoms of anxiety and depression as a function of genotype and environment: A longitudinal twin study from ages 3 to 63 years. *Psychological Medicine*, *45*(5), 1039–1049. https://doi.org/10.1017/S003329171400213X.

OECD. (2016). *Education at a glance 2016: OECD Indicators*. Paris: OECD Publishing. https://doi.org/10.1787/eag-2016-en.

Parhiala, P., Torppa, M., Eklund, K., Aro, T., Poikkeus, A-M., & Lyytinen, H. (2015). Psychosocial functioning of children with and without dyslexia: A follow up study from age 4 to age 9. *Dyslexia*, *3*, 197–211. https://doi.org/10.1002/dys.1486.

Parhiala, P., Torppa, M., Vasalampi, K., Eklund, K., Poikkeus, A. M., & Aro, T. (2018). Profiles of school motivation and emotional well-being among adolescents: Associations with math and reading performance. *Learning and Individual Differences*, *61*, 196–204. https://doi.org/10.1016/j.lindif.2017.12.003.

Parviainen, M., Aunola, K., Torppa, M., Poikkeus, A. M., & Vasalampi, K. (2020). Symptoms of psychological ill-being and school dropout intentions among upper secondary education students: A person-centered approach. *Learning and Individual Differences*, *80*, 101853. https://doi.org/10.1016/j.lindif.2020.101853.

Räsänen, P., & Leino, L. (2005). *KTLT. Laskutaidon testi. Opas yksilö- tai ryhmämuotoista arviointiavarten [KTLT. Arithmetic skills test. Manual for individual or group assessment]*. Jyväskylä: NMI.

Rao, U., & Chen, L. A. (2009). Characteristics, correlates, and outcomes of childhood and adolescent depressive disorders. *Dialogues in Clinical Neuroscience*, *11*(1), 45–62. https://doi.org/10.31887/DCNS.2009.11.1/urao.

Raskind, M. H., Goldberg, R. J., Higgins, E. L., & Herman, K. L. (1999). Patterns of change and predictors of success in individuals with learning disabilities: Results from a twenty-year longitudinal study. *Learning Disabilities Research & Practice*, *14*(1), 35–49. https://doi.org/10.1207/sldrp1401_4.

Rimkute, L., Torppa, M., Eklund, K., Nurmi, J.-E. & Lyytinen, H. (2014). The impact of adolescents' dyslexia on parents' and their own educational expectations. *Reading and Writing: an Interdisciplinary Journal*, *27*, 1231–1253. https://doi.org/10.1007/s11145-013-9484-x.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, *25*, 54–67. https://doi.org/10.1006/ceps.1999.1020.

Salmela-Aro, K., & Tynkkynen, L. (2012). Gendered pathways in school burnout among adolescents. *Journal of Adolescence*, *35*(4), 929–939. https://doi.org/10.1016/j.adolescence.2012.01.001.

Salmela-Aro, K., Kiuru, N., & Nurmi, J. E. (2008). The role of educational track in adolescents' school burnout: A longitudinal study. *British Journal of Educational Psychology*, *78*(4), 663–689. https://doi.org/10.1348/000709908X281628.

Seymour, P. H., Aro, M., & Erskine, J. M., & Collaboration with COST action A8 network. (2003). Foundation literacy acquisition in european orthographies. *British Journal of Psychology*, *94*(*2*), 143–174. https://doi.org/10.1348/000712603321661859

Snowling, M. J., Muter, V., & Carroll, J. (2007). Children at family risk of dyslexia: A follow-up in early adolescence. *Journal of Child Psychology and Psychiatry*, *48*(6), 609–618. https://doi.org/10.1111/j.1469-7610.2006.01725.x.

Sowislo, J. F., & Orth, U. (2013). Does low self-esteem predict depression and anxiety? A meta-analysis of longitudinal studies. *Psychological Bulletin*, *139*, 213–240. https://doi.org/10.1037/a0028931.

Spinath, B., & Spinath, F. M. (2005). Longitudinal analysis of the link between learning motivation and competence beliefs among elementary school children. *Learning and Instruction*, *15*, 87–102. https://doi.org/10.1016/j.learninstruc.2005.04.008.

Sterba, S. K., Prinstein, M. J., & Cox, M. J. (2007). Trajectories of internalizing problems across childhood: Heterogeneity, external validity, and gender differences. *Development and Psychopathology*, *19*(2), 345–366. https://doi.org/10.1017/S0954579407070174.

Stoet, G., & Geary, D. C. (2013). Sex differences in mathematics and reading achievement are inversely related: Within- and across-nation assessment of 10 years of PISA data. *PLOS ONE*, *8*(3), e57988. https://doi.org/10.1371/journal.pone.0057988.

Taylor, L. M., Hume, I. R., & Welsh, N. (2010). Labelling and self-esteem: The impact of using specific vs. generic labels. *Educational Psychology*, *30*(2), 191–202. https://doi.org/10.1080/01443410903494478.

Tennant, R., Hiller, L., Fishwick, R., Platt, S., Joseph, S., Weich, S., Parkinson, J., Secker, J., & Stewart-Brown, S. (2007). The Warwick-Edinburgh Mental Well-being scale (WEMWBS): Development and UK validation. *Health and Quality of Life Outcomes*, *5*(63), 1–13. https://doi.org/10.1186/1477-7525-5-63.

Torppa, M., Eklund, K., Sulkunen, S., Niemi, P., & Ahonen, T. (2018). Why do boys and girls perform differently on PISA Reading in Finland? The effects of reading fluency, achievement behaviour, leisure reading and homework activity. *Journal of Research in Reading*, *41*(1), 122–139. https://doi.org/10.1111/1467-9817.12103.

Undheim, A. M., & Sund, A. M. (2008). Psychosocial factors and reading difficulties: Students with reading difficulties from a representative population sample. *Scandinavian Journal of Psychology*, *49*, 377–384.

Valentine, J. C., DuBois, D. L., & Cooper, H. (2004). The relation between self-beliefs and academic achievement: A meta-analytic review. *Educational Psychologist*, *39*(2), 111–133. https://doi.org/10.1207/s15326985ep3902_3.

Viljaranta, J., Tolvanen, A., Aunola, K., & Nurmi, J. E. (2014). The developmental dynamics between interest, self-concept of ability, and academic performance. *Scandinavian Journal of Educational Research*, *58*(6), 734–756. https://doi.org/10.1080/00313831.2014.904419.

Wakeman, H. N., Wadsworth, S. J., Olson, R. K., DeFries, J. C., Pennington, B. F., & Willcutt, E. G. (2022). Mathematics Difficulties and Psychopathology in School-Aged Children. *Journal of Learning Disabilities*, online first. https://doi.org/10.1177/0022219422108413

Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology*, *25*, 68–81. https://doi.org/10.1006/ceps.1999.1015.

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

Wigfield, A., Cambria, J., & Eccles, J. S. (2012). Motivation in education. In R. M. Ryan (Ed.), *The Oxford handbook of human motivation* (pp. 463–478). Oxford University Press.

Willcutt, E. G., Petrill, S. A., Wu, S., Boada, R., DeFries, J. C., Olson, R. K., & Pennington, B. F. (2013). Comorbidity between reading disability and math disability: Concurrent psychopathology, functional impairment, and neuropsychological functioning. *Journal of Learning Disabilities*, *46*(6), 500–516. https://doi.org/10.1177/0022219413477476.

Wilson, A. M., Armstrong, C. D., Furrie, A., & Walcot, E. (2009). The mental health of Canadians with self-reported learning disabilities. *Journal of Learning Disabilities*, *41*(1), 24–40. https://doi.org/10.1177/0022219408326216.

Wouters, S., Colpin, H., Van Damme, J., De Laet, S., & Verschueren, K. (2013). Early adolescents' academic self-concept formation: Do classmates or friends matter most? *Learning and Individual Differences*, *27*, 193–200. https://doi.org/10.1016/j.lindif.2013.09.002.

Wu, H., Guo, Y., Yang, Y., Zhao, L., & Guo, C. (2021). A meta-analysis of the longitudinal relationship between academic self-concept and academic achievement. *Educational Psychology Review*, *33*(4), 1749–1778. https://doi.org/10.1007/s10648-021-09600-1.

Zahn-Waxler, C., Klimes-Dougan, B., & Slattery, M. J. (2000). Internalizing problems of childhood and adolescence: Prospects, pitfalls, and progress in understanding the development of anxiety and depression. *Development and Psychopathology*, *12*, 443–466. https://doi.org/10.1017/S0954579400003102.

Zeleke, S. (2004). Self-concepts of students with learning disabilities and their normally achieving peers: A review. *European Journal of Special Needs Education*, *19*(2), 145–170. https://doi.org/10.1080/08856250410001678469.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.