

Research Article

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Associations Between Parenting Stress and Children's Academic Engagement When Schools Were Closed During the COVID-19 Pandemic: Risk and Protective Factors

<https://doi.org/10.1515/edu-2022-0012>

received June 1, 2021; accepted March 31, 2022.

Abstract: The present study investigated associations between parenting stress and children's academic engagement when schools were closed in spring/early summer 2020. We investigated four dimensions of children's academic engagement, i.e., behavioral, cognitive, emotional, and agentic. Participants of this online survey study were 78 families (75 mothers and 54 fathers), recruited in the United States from advertisements on Facebook in May 2020. Children were, on average, 11.05 years old ($SD=3.73$). Out of the total sample, 46 parents also consented for their child to participate in the study. Contrary to our expectations, we did not find evidence for direct associations between parenting stress and children's academic engagement. However, our findings suggest that the associations between parenting stress and children's academic engagement is moderated by children's interest in at-home learning activities and the length of homeschooling. Recommendations for future research on the effects of the pandemic on children's learning are discussed.

Keywords: learning; involvement; parents; at-home education; COVID-19.

1 Introduction

Children's academic engagement, i.e., their active involvement in a learning activity, functions as a student-initiated pathway connecting their educational goals with

sought-after outcomes, such as academic progress (Reeve, 2013; Reeve & Lee, 2014). Engagement is an inherent aspect of the learning process and, consequently, critical to children's academic experience and school success (Skinner, Pitzer, & Steele, 2016). Engagement develops through discourse and shared activities between teachers and students (Reeve, 2013; Turner et al., 2014). Through the design of learning activities and the use of instructional practices, such as questions and feedback, teachers provide opportunities for engagement (Schmidt, Rosenberg, & Beymer, 2018; Turner et al., 2014). Students' willingness to engage, or the extent to take up those opportunities, shape their participation in learning activities. As such, engagement is argued to be a proximal process that is highly influenced by context (Schmidt et al., 2018).

When many governments announced nationwide school closures in March 2020 to contain the spread of the coronavirus, the context for and nature of educational interactions changed radically and concerns have been raised quickly that homeschooling may not be an effective replacement for in-person interactions between students and teachers that keep students engaged in learning (Parczewska, 2020). Simultaneously and without preparation, millions of parents had to take over an additional role, that of being a teacher for their child, and were encouraged, or even had the duty, to take an active role in their child's online schoolwork and to foster the child's engagement in remote learning activities at home. Yet, the outbreak of the COVID-19 pandemic had a negative impact on parents as well, with recent studies finding a significant increase in parents' negative mood (e.g., Gassman-Pines et al., 2020). Temporary school closures impacted millions of parents who were confronted with sudden changes to child care and schooling arrangements. The present study investigated associations between parenting stress

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and children's engagement in homeschooling¹ during the COVID-19 pandemic. More specifically, main and interactive effects of various risk and protective factors of parenting stress in relation to children's academic engagement were examined.

In the following sections, we first provide an overview of the relevant literature. Next, we introduce the conceptual framework and the research objectives. We then describe the sample, measures, analytical strategy, and the results. Finally, in the discussion we summarize the results and provide an explanation for the present findings, and highlight important limitations of the study that future research should address.

1.1 The COVID-19 pandemic in the United States during Spring 2020

In the United States, where the data for the present study was collected, COVID-19 was declared a public health emergency on February 3, 2020, and a national emergency on March 13, 2020. The first COVID-19 case was recorded on January 21, 2020. By the end of May 2020, there were more than 1.8 million cumulative cases and more than 100,000 deaths recorded (AJMC Staff, 2021). In March 2020, several states imposed lockdowns to curb the spread of the virus. Ohio was the first state to close all schools on March 12, 2020. By March 25, 2020, all public schools in the United States were shut down and remained closed until the end of the academic year 2019-2020, affecting 55.1 million school-aged children (EducationWeek, 2020). The prolonged closure of schools has impacted children's education. It is estimated that the initial shutdown of schools in the Spring of 2020 resulted in 1-3 months of "unfinished learning", that is, almost no new content was learned in math and reading (Dorn, Hancock, Sarakatsannis, & Viruleg, 2021). Children and their families, however, were not only impeded by the shutdown of schools but also by the economic challenges due to the pandemic. A report by the Brookings Institute estimates that 2.2 million mothers and 870,000 fathers of children 12 years old and younger lost their job between February and August 2020, increasing financial concerns in these families (Bateman & Ross, 2020). The high job loss among mothers is explained by the fact that women

in the United States are disproportionately represented in jobs paying low wages (jobs that could not be transitioned to remote work but were furloughed or laid off in the pandemic) and due to the lack or loss of childcare (Bateman & Ross, 2020).

1.2 Children's academic engagement

Children's academic engagement has been studied from multiple disciplinary perspectives. Synthesizing the theoretical and empirical work, Christenson, Reschly, and Wylie (2012) defined engagement as "the student's active participation in academic and co-curricular or school-related activities, and commitment to educational goals and learning" (p. 816). Engagement encompasses multiple dimensions, such as behavioral, emotional, cognitive, and agentic (e.g., Christenson et al., 2012; Reeve, 2013; Reeve & Lee, 2014; Turner et al., 2014). While these dimensions are distinct aspects of engagement, they are intercorrelated and mutually supportive (Reeve, 2013; Reeve & Lee, 2014). Behavioral engagement describes a student's effortful involvement in academic activities, such as the student's active initiation and participation, effort, attention, and persistence (Skinner, Kindermann, & Furrer, 2009). Emotional (or affective) engagement refers to the presence of positive emotions, such as interest, and the absence of negative emotions, such as anxiety, that students have while they participate in learning activities (Skinner et al., 2016). Emotional engagement strengthens a student's sense of belonging and increases her or his willingness to complete schoolwork (Schmidt et al., 2018). Cognitive engagement refers to how a student approaches a learning activity (with a focus on elaboration vs. memorization) and the learning strategies she or he uses (with a focus on using sophisticated vs. superficial strategies) (Reeve & Lee, 2014). Agentic engagement refers to "the extent of the student's constructive contribution into the flow of the instruction they receive in terms of asking questions, expressing preferences, and letting the teacher know what one wants and needs" (Reeve & Lee, 2014, p. 529; Reeve, 2013). It also describes the student's attempts to add personal relevance to the learning activity and the academic content learned (Reeve, 2013). Together, the four dimensions of engagement help students to be actively involved in learning activities and to maintain this active involvement in order to reach desired educational outcomes.

Engagement has been operationalized as "students' momentary states while interacting with academic content" (Schmidt et al., 2018, p. 21). The framework

¹ Note that homeschooling due to the COVID-19 pandemic is different from regular homeschooling, that is, when parents deliberately decide to provide educational activities in a home-based setting. In the U.S., approx. 1.7 million children were homeschooled by their parents prior to the COVID-19 pandemic (Lee et al., 2020).

of momentary engagement reflects a situated view of engagement that emphasizes the role of the context in which students' motivated beliefs and behaviors occur in shaping engagement (Nolen, Horn, & Ward, 2015). Nationwide school closures were unprecedented and a large disruption to education processes. From one day to the next, homeschooling became mandatory and presented a sudden change to the context of teaching and learning, both with regard to the actual learning environment (from learning in the classroom to learning at home) and the interpersonal relationships that help construct and regulate children's engagement (from teachers and students participating in classroom activities to parents organizing children's participation in remote learning activities). Yet, we lack knowledge about children's engagement in the context of remote learning and the factors that may shape it.

1.3 Parenting stress during the COVID-19 pandemic

The COVID-19 pandemic disrupted the everyday lives of most families. The stringent measures to curtail the virus spread, including restrictions to leave home except for non-deferrable and proven work or health reasons, social distancing mandates, and the shutdown of schools changed the living conditions of families, with potentially severe consequences for families' ability to rationally solve tasks and function efficiently (e.g., Lee, Ward, Chang, & Downing, 2020; Spinelli, Lionetti, Pastore, & Fasolo, 2020; Parczewska, 2020). The situation posed a major burden on parents; not only did they need to take care of homeschooling their children but they also needed to continue their job commitments while their children were around (Lee et al., 2020; Spinelli et al., 2020).

In accord with the Family Stress Model (Masarik & Conger, 2017), the emergency caused by the COVID-19 pandemic, including the struggles and challenges associated the sudden transition to at-home education, are likely to impact parents' psychological well-being and ability to carry out parenting responsibilities (e.g., Lee et al., 2020; Letzel, Pozas, & Schneider, 2020; Mikuska, Kahn, & Kurowski, 2021; Spinelli et al., 2020). Schools were closed from one day to the next, leaving parents with little (or no) time to reorganize their job commitments and prepare to take on the new educational role (Lee et al., 2020; Parczewska, 2020). As most parents were not educators, providing their children with the necessary support to ensure that they understand new content and engage in educational activities places a considerable

burden on parents (Lee et al., 2020). Research shows that parents were "far more involved in their children's school issues during homeschooling, compared to classroom schooling" (Letzel et al., 2020, p. 164). For example, the time parents spent on taking care of their child's school tasks and assignments increased for many parents from approx. 30-60 minutes per day prior to the pandemic to up to four hours during homeschooling (Wildemann & Hosenfeld, 2020). It is not surprising that parents' risk of experiencing stress and negative emotions increased during the COVID-19 outbreak (e.g., Letzel et al., 2020; Spinelli et al., 2020). During homeschooling, parents reported to feel "far less energetic, more stressed, tired, angry, listless, nervous, bored and quite worried in comparison to normal school-based instruction" (Letzel et al., 2020, p. 165). Importantly, the stress was not only experienced at the individual level but also at the dyadic level (Letzel et al., 2020; Spinelli et al., 2020; Wildemann & Hosenfeld, 2020). Parents reported to have more arguments with the child and found it more difficult to enjoy interactions with the child (Letzel et al., 2020; Spinelli et al., 2020). They also reported to struggle with keeping their child engaged in school tasks (Letzel et al., 2020).

Even under "normal" circumstances, parenting is a challenging process and parents differ in the extent to which they experience raising children as stressful (Cooper, McLanahan, Meadows, & Brookes-Gunn, 2009). Parenting stress has been defined as "a condition or feeling experienced when a parent perceives that the demands associated with parenting exceed the personal and social resources available to meet those demands" (Cooper et al., 2009, p. 559). In particular parents with school-aged children struggle to balance work, child care, and homeschooling during the pandemic (Lee et al., 2020). These challenges can also have negative effects on the parents' marital relationship quality and increase marital conflict (Pietromonaco & Overall, 2021). In times of crisis, parents may turn to social, educational, and community supports that may buffer negative impacts on families' functioning. Yet, the social distancing removed many of these options, and parents were largely left alone in taking care of home-schooling their children (Lee et al., 2020; Spinelli et al., 2020). Given the continued virulence of the sars-cov-2 virus, there is an imperative need to understand family processes, protective factors, and risk factors in the home environment to promote the well-being of parents and children in these difficult times (Wang et al., 2020).

1.4 Risk and protective factors

A variety of risk and protective factors may be linked to family stress processes and child adjustment. Assessed risk factors that were deemed relevant in the context of the COVID-19 pandemic included health problems, number of children homeschooled, and length of homeschooling. Protective factors included perceived support from school and satisfaction with school support and parents' online social network.

1.4.1 Risk factors

Parents who are mentally and physically healthy are better able to cope with the challenges of parenting and to meet their child's needs. As previous research has documented strong associations between stressful life events and health (Tosevski & Milovancevic, 2006), in times of crisis, parents' health might be impacted which, in turn, might lead to more family stress (Anderson, 2009). Emerging research on the consequences of COVID-19 for mental health documents that parents, compared to adults without children, report significantly greater levels of stress (APA, 2020). A considerable amount of stress stemmed from managing their children's online/distance learning and adapting to new routines (APA, 2020). The burden of at-home education might be even more pronounced in families with more than one school-aged child. In addition, the challenges of balancing work responsibilities with at-home education and child care might increase with the length of imposed closure of schools. In many countries, the shutdown of schools was initially planned to last a few weeks during the semester. However, with the rapid spread of the virus, the shutdown was extended until the end of the school year in early summer 2020. Thus, parental supervision of their children's at-home education lasted longer than families might have expected, potentially worsening the already difficult conditions.

1.4.2 Protective factors

When schools were closed and in-person educational activities suspended, online resources served as a temporary replacement for classroom instruction (Lee et al., 2020). Many schools borrowed resources and strategies used by regular homeschooling parents, for example, online programs (Hanna, 2012; Lee et al., 2020). Yet, significant variations in (or even lack of) requirements for

schools regarding plan or policy preparedness prior to the COVID-19 pandemic that address issues such as flexible or remote instruction, or students' access to services when schools are closed, resulted in often spotty solutions (Lee et al., 2020; Nuñez, Stuart-Cassel, & Temkin, 2020). Consequently, the support that parents receive from their child's school might differ widely. It is reasonable to assume that parents who perceive high levels of school support and are satisfied with the support might struggle less with supervising at-home education.

Many parents were not prepared for taking over the responsibility for their children's schooling. Under "normal" circumstances, useful resources to cope with emergencies are obtained through face-to-face relationships with family, friends, and community members. Yet, the abrupt lifestyle changes during the COVID-19 pandemic, in particular, the urge to practice social distancing, limit in-person contact with others. In this context, social media may become important sources of support, thus, shaping the conditions for children's homeschooling. Prior research has shown that parents use online resources for information seeking and social support (Jang, Dworkin, & Hessel, 2015). For example, previous research found that Facebook use predicted adjustment to parenthood for new parents (Bartholomew et al., 2012). Social media can thus play a crucial role "in how parents manage their everyday parenting issues as well as deal with crisis situations" (Jang et al., 2015, p. 221).

1.5 The present study

The sudden shift from in-person to at-home education, together with the uncertainties associated with the COVID-19 pandemic, can be seen as an acute stressor. In this context, the present study investigated associations between parenting stress and children's academic engagement when schools were closed during the first spike of COVID-19 infections in spring/early summer 2020. More specifically, main and interactive effects of various risk and protective factors of parenting stress in relation to children's engagement in at-home education were examined (see Figure 1). We hypothesized that parenting stress is negatively associated with children's engagement. We also expected risk factors to be related to higher levels of parenting stress and lower levels of children's engagement, and supportive factors to lower levels of parenting stress and higher levels of children's engagement. Our investigation of interactive effects was explorative due to the novelty of the emergency

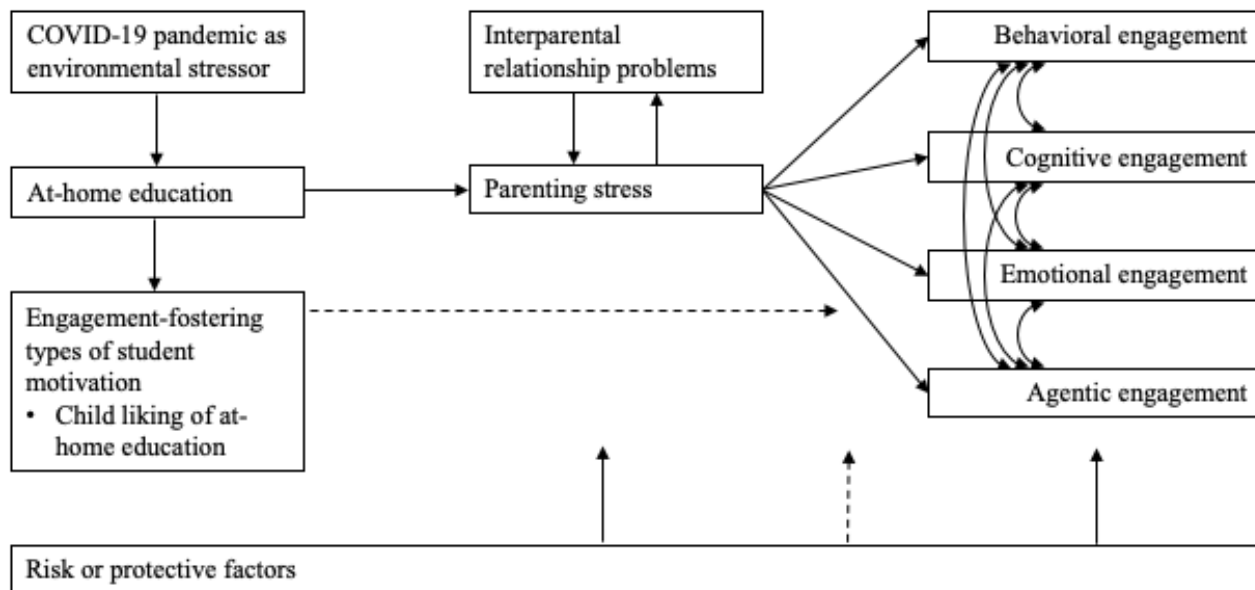


Figure 1: Conceptual framework outlining the associations between parenting stress and children’s engagement during at-home education in the context of the COVID-19 pandemic. The curved lines reflect the interrelations between dimensions of student engagement; solid lines reflect main effects; dashed lines reflect indirect/interactive effects.

homeschooling and we, therefore, did not formulate specific hypotheses.

Over the past two decades fathering research has been growing. Nevertheless, research involving families and child outcomes remains dominated by studies focused on associations between mothers’ parenting and child development (Roy & Kwon, 2007). In addition, most studies that use parents’ reports involve mothers as respondents (Roy & Kwon, 2007). The present study included mothers’ and fathers’ reports of their parenting stress, their individual perception of risk and protective factors, and their child’s engagement in at-home education. In addition, with parental consent, we also included the child’s own perception of their engagement. The inclusion of multiple respondents allowed us to explore whether patterns of associations were dependent on the respondent.

2 Methods

2.1 Participants

Participants were recruited in the United States from advertisements on Facebook. In total, 258 link clicks to the online enrollment were registered during the enrollment period in May 2020. The link included details about the study and screening questions. Participants who met

the inclusion criteria and consented to participate in the study ($n=192$) were asked to leave their and their parenting partner’s email address. Valid email addresses were available for 126 participants of whom 48 did not respond to the survey despite reminders that were sent over the course of one week following the enrollment. The total sample included 78 families. Data were available from 75 mothers ($M_{age}=39.59$ years, $SD=5.80$) and 54 fathers ($M_{age}=41.62$ years, $SD=7.44$). From 51 families, data were available for both, mother and father. Participants self-identified² as White (mothers: 84%; fathers: 66%), Black (mothers: 6%; fathers: 12%), Hispanic (mothers: 7%; fathers: 12%), Asian (fathers: 8%), and Native American (fathers: 2%). Of the participating mothers, 40% worked full-time and 13% part-time. The majority of fathers worked full-time (78%); 8% worked part-time. The remaining participants were not employed at the time of data collection. Parents’ education was, on average, 16 years of schooling ($SD=3.63$) for mothers and 15 years of schooling ($SD=3.14$) for fathers.

Parents were asked to refer to their firstborn child who was homeschooled at the time of data collection as the subject of this study. Mothers reported the child’s age and gender. Children (38 boys, 35 girls; missing information for 5 children) were, on average, 11.05 years old ($SD=3.73$). At the time of enrollment, homeschooling

² missing information for 3% of mothers

of children lasted for almost 9 weeks ($M=8.72$, $SD=1.85$). In most families ($n=55$), mothers were primarily responsible for the homeschooling of their children. In 17 families, parents shared the responsibility of homeschooling. Almost all families reported that they had high-speed internet ($n=67$) and a computer available for the child to use for remote learning and schoolwork ($n=69$) (missing information for 6 families).

Out of the total sample, 46 parents consented for their child to participate in the survey. Children who completed the child survey (30 boys, 16 girls) were, on average, 10.15 years old ($SD=3.35$, range 7-17 years). Complete information from mother-father-child triads was available for 40 families. Partially complete information was available for mother and child in 46 families, and for father and child in 40 families.

2.2 Procedure

The study was approved by the first author's university's IRB (HRPP-2020-58) and conducted in accordance with human subject guidelines. Informed consent has been obtained from all individuals included in this study. Following the successful enrollment, mothers and fathers received separate links to the online survey which they completed between mid- and end-May 2020. Parents were asked to report their perceived parenting stress. Assessed risk factors included spousal relationship problems, health problems, number of children homeschooled, and time in weeks in emergency homeschooling. Protective factors included perceived support from their child's school and satisfaction with the school's support, and parents' online social network. Parents were asked to complete the survey in private; they were asked to not discuss their answers with their parenting partner. The completion of the survey took approx. 15-20 minutes. At the end of the survey, parents could click on a link to the child survey when they consented to their child to participate. The child was asked about his/her liking of homeschooling and engagement with homeschooling. The same questions about the child's engagement with homeschooling were also included in the parent survey. It took approx. 10 minutes to complete the child survey. Parents were asked to set up the survey for the child but not to answer the questions for their child. Upon completion, each family received an Amazon gift voucher worth 10 USD.

2.3 Measures

2.3.1 Children's engagement with homeschooling

We adapted published items that assess four aspects of children's engagement: behavioral, emotional, cognitive, and agentic (Reeve, 2013) to the homeschooling context. Instead of using "During class" as the reference for assessing aspects of student engagement (Reeve, 2013), the items referred to the structured learning time at home that was introduced as time during which the child was engaged in learning activities and not free to do whatever s/he chooses. The behavior engagement scale included 5 items (e.g., *I pay attention during structured learning time* – original item *I pay attention in this class*). Agentic engagement was measured with 7 items (e.g., *I let my parent/teacher know what I am interested in* – original item *I let my teacher know what I am interested in*). Emotional engagement was measured with 5 items (e.g., *Structured learning time is fun* – original item *This class is fun*). The cognitive engagement scale included 4 items (e.g., *When doing work during structured learning time, I try to relate what I'm learning to what I already know.* – original item *When doing work for this class, I try to relate what I'm learning to what I already know*). Following prior research (Duckworth & Seligman, 2005; Gunzenhauser, Suchodoletz, & McClelland, 2017), items were rephrased from self-ratings to parent-ratings for mothers and fathers to report on their child's engagement with homeschooling, using "my child". Items used a 7-point Likert-type response scale, 1=*strongly disagree* to 7=*strongly agree* (Reeve, 2013).

2.3.2 Children's liking of homeschooling

One item was used to assess children's liking of homeschooling (*Overall, how much do you like homeschooling?*). Children were asked to use a slider, with 0 indicating that s/he does not like homeschooling at all and 10 indicating that s/he likes homeschooling a lot.

2.3.3 Parenting stress

We used the parenting stress items from the Fragile Families and Child Wellbeing Study (Cooper et al., 2009). Mothers and fathers were asked to rate four statements (e.g., *I feel trapped by my responsibilities as a parent*) with regard to how they feel at the moment in their role as a parent. The items used a 4-point scale (1=*strongly disagree* to 4=*strongly agree*).

2.3.4 Interparental relationship problems

Interparental relationship problems were assessed using three items of the Parental Distress subscale of the Parenting Stress Index (PSI; Abidin, 1995) that measure a parent's perceived conflict with the spouse or partner. Mothers and fathers were asked to rate their agreement (1 = *strongly disagree* to 5 = *strongly agree*) with the statements (e.g., *Problems happened in my relationship with my partner more than I expected*).

2.3.5 Risk factors

Assessed risk factors included health problems, number of children homeschooled, and length of homeschooling. Mothers' and fathers' health problems were measured using 7 items from the PSI (Abidin, 1995). Mothers and fathers rated their agreement (1 = *strongly disagree* to 5 = *strongly agree*) with the statements (e.g., *My health was more affected than usual or I had more aches and pains than I have under normal circumstances*). Mothers also indicated how many children were being homeschooled in the family, and how many weeks their firstborn child's school was closed.

2.3.6 Protective factors

Assessed protective factors included resources, school support and satisfaction with school support, and parents' online social networks. Informed by prior research (Hanna, 2012; Ray, 2010), mothers reported on the resources and materials they used to support the emergency homeschooling of their child (10 items; e.g., traditional textbooks; texts/resources provided by the school/teacher; resources purchased by the parent). In addition, mothers reported on the support from their child's school during the emergency homeschooling (5 items; e.g., regular morning check-ins with the teacher using video-conferencing; teacher provides regular lesson plans, assignments, and other learning resources). For both variables, a sum score was created, with higher scores reflecting more resources being used/more support being received from the school. Both mothers and fathers reported individually their satisfaction with the school's support, using a 7-point Likert-type scale (1=*extremely dissatisfied* to 7=*extremely satisfied*). Finally, parents reported on their online social networks using items from prior research on parents' Facebook use (Bartholomew et al., 2012). One question tapped the size of the network.

Two questions asked about the frequency of Facebook use that were combined into one single score, with higher values reflecting higher frequency of Facebook use. Three questions asked about content management in relation to emergency homeschooling that were also combined into one single score, with higher values reflecting a higher intensity of homeschooling-related content management.

2.4 Statistical analyses

The statistical analyses were conducted in MPLUS version 8.4. To retain the sample of 78 families, full information maximum likelihood was used to estimate missing data values (Kline, 2011). To measure the psychometric properties, CFAs³ were run using the maximum-likelihood estimator MLR (an exception was parenting stress where the WLSMV estimator was used because the scale used less than five response options). The fit indices observed were the RMSEA, CFI, TLI, and SRMR⁴. The cut-offs used were based on recommendations for appropriate fit, i.e., values below 0.08 for RMSEA and SRMR and above 0.9 for CFI and TLI (Wang & Wang, 2012). A model was determined to have an appropriate fit if three out of four of the mentioned indices met the recommendations. Following prior research on children's engagement (e.g., Reeve, 2013; Reeve & Lee, 2014), a CFA was run including all four types of engagement in a four-factor model. The CFAs were run for each respondent separately (i.e., mother, father, child). For parenting stress, interparental relationship problems, and parents' health problems, one-factor models were used and run separately for mother and father. After ensuring all latent variables had an appropriate fit with CFAs, measurement invariance was tested to confirm that the variables were invariant across respondents⁵. Configural invariance was met using the same criteria as the CFA. Metric and scalar invariance were met using the criteria from Cheung and Rensvold (2002), which is for the change in CFI to be less than 0.01 (as cited in Wang & Wang, 2012, pp. 211-212). In addition, omega values were extracted from the CFAs as a measure of internal consistency.

After measurement invariance across respondents was established, associations between parenting stress

³ CFA: Confirmatory Factor Analysis.

⁴ RMSEA: Root Mean Square Error of Approximation; CFI: Comparative Fit Index; TLI: Tucker-Lewis Index; SRMR: Standard Root Mean Square Residual.

⁵ Child engagement across mother, father, and child; parenting stress, interparental relationship problems, and parents' health problems across mother and father.

and children's engagement were tested in a structural equation modeling framework. The models were initially run including the items for the latent variables. However, the parameters of the model exceeded the sample size and led to convergence issues. To free up parameters, all latent variables were exported as factor scores using the MLR estimator. The one exception to this was the factor scores for parenting stress. Factor scores are unable to export with the WLSMV estimator, so the BAYES estimator was used. The factor scores for children's engagement were used as dependent variables. The variables were allowed to correlate to reflect theoretical frameworks of children's engagement that argue the different dimensions of engagement are intercorrelated and mutually supportive (Reeve, 2013; Reeve & Lee, 2014). The main independent variable of interest was parenting stress. Additional variables included a child's liking of homeschooling and the various risk and protective factors. Due to the small sample size and the number of estimated parameters, demographic control variables (i.e., child age and gender, mother's/father's age, and education) were only added if preliminary (i.e., correlational) analyses indicated a significant relation with parenting stress or children's engagement. Based on these results, only child age was included in the models. This conservative strategy was also used in other studies to avoid problems with model convergence and to keep a parsimonious model. We first tested for the main effects of parenting stress on children's engagement. We also tested for main effects of the risk/protective factors on parenting stress and on children's engagement. Next, we tested for interactive effects; child's liking of homeschooling and all risk/protective factors were tested as moderators of the association between parenting stress and children's engagement. Interaction variables⁶ were created for parenting stress with child liking of homeschooling and parenting stress with the individual risk/protective factors. Model trimming was applied for each step by eliminating non-significant paths (Wuensch, 2012) to obtain the most parsimonious model. To account for the different respondents, the models were run with various combinations of respondent-reported variables. The combinations included mother-reported parenting stress and risk/protective factors on mother-reported child engagement (model M-M), mother-reported parenting stress and risk/protective factors on child-reported child engagement (model M-C), father-reported parenting stress, and risk/protective factors on father-reported child engagement (model F-F), and

father-reported parenting stress and risk/protective factors on child-reported child engagement (F-C). Due to the number of models run, a Bonferroni alpha correction was applied. Effects significant at $p < .0125$ are presented⁷ and interpreted. The magnitude of change between the independent and dependent variables is presented in standardized beta weights in the tables. These depict the average change to the outcome variable as measured in standard deviations for every one standard deviation increase to the relevant independent variable (in the presence of all other independent variables).

3 Results

3.1 Confirmatory factor analyses and measurement invariance

3.1.1 Children's engagement with homeschooling

The CFA for the four-factor model did not meet the fit statistics thresholds set forth in the literature (Table S1 in the online supplement). There were no modification indices that were high enough to increase model fit. To reduce the complexity of the model but keep with the theoretically important four-factor structure, separate CFAs were run for each factor (e.g., *behavioral engagement*, *cognitive engagement*, *emotional engagement*, *agentic engagement*) to isolate misfit in each factor. The fit statistics were acceptable for cognitive engagement. However, for the other three factors, not all fit statistics thresholds were met (Table S2 in the online supplement) and additional modifications were necessary to reach acceptable model fit. Modifications included dropping items that did not show sufficient consistency with the construct and allowing the residual variances of items to correlate (according to modification indices and theoretical considerations). Together, these modifications led to an acceptable model fit of all four engagement factors (Table 1) and to measurement invariance across mother-, father-, and child-reported engagement (Table 2). Additionally, the omega values for all four engagement factors were at least 0.787 and significant at $p < 0.001$.

3.1.2 Parenting stress

The CFA on mother-reported parenting stress did not have good model fit (RMSEA=0.251, CFI=0.958, TLI=0.873,

⁶ Variables were centered first before they were used to create interaction terms.

⁷ In the tables, we also report effects significant $p < .05$ for comparison.

Table 1: Fit statistics for the separate, modified CFAs for each dimension of children's engagement.

	RMSEA (<.08)	CFI (>.90)	TLI (>.90)	SRMR (<.08)
Behavioral engagement ^a				
Mother-reported child engagement	0.041	0.997	0.992	0.022
Father-reported child engagement	0.137	0.969	0.907	0.046
Child-reported child engagement	0.065	0.990	0.970	0.031
Cognitive engagement				
Mother-reported child engagement	0.000	1.000	1.000	0.006
Father-reported child engagement	0.000	1.000	1.000	0.018
Child-reported child engagement	0.107	0.982	0.946	0.030
Emotional engagement ^b				
Mother-reported child engagement	0.086	0.992	0.962	0.019
Father-reported child engagement	0.090	0.993	0.965	0.016
Child-reported child engagement	0.000	1.000	1.000	0.006
Agentic engagement ^c				
Mother-reported child engagement	0.000	1.000	1.000	0.022
Father-reported child engagement	0.000	1.000	1.000	0.012
Child-reported child engagement	0.000	1.000	1.000	0.031

Note. ^a Item *My child pays attention during structured learning time* was dropped. ^b The residual variance of the item *Structured learning time is fun for my child* was allowed to correlate with the residual variances of the items *My child enjoys learning new things during structured learning time* and *During structured learning time, my child feels good*. The residual variance of the item *When we work on something during structured learning time, my child is interested* was allowed to correlate with the residual variance of the item *When we work on something during structured learning time, my child gets involved*. ^c Items *During structured learning time, my child expresses her/his preferences and opinions* and *During structured learning time, my child asks questions to help her/him learn* were dropped. The residual variance of the item *My child lets me know what she/he is interested in* was allowed to correlate with the residual variance of the item *When my child needs something during structured learning time, she/he'll ask me for it*. Furthermore, the residual variance of the item *My child adjusts whatever we are learning so that she/he can learn as much as possible* was allowed to correlate with the residual variance of the item *My child tries to make whatever we are learning as interesting as possible*.

SRMR=0.044). To improve model fit, modification indices were used based on which the residual variance of the item *Being a parent is harder than I thought it would be* was allowed to correlate with the residual variance of the item *I feel trapped by my responsibilities as a parent*. This resulted in acceptable model fit (RMSEA=0.093, CFI=0.997, TLI=0.983, SRMR=0.015). Although the CFA on father-reported parenting stress showed initial acceptable model fit (RMSEA=0.000, CFI=1.000, TLI=1.000, SRMR=0.008), we also specified the same modification as in the mother-reported parenting stress model to ensure the models are comparable. The model fit for father-reported parenting stress remained acceptable (RMSEA=0.000, CFI=1.000, TLI=1.000, SRMR=0.006). Measurement invariance was met across mother- and father-reported parenting stress (Table 3 for fit statistics). The omega values extracted

from the CFAs were 0.825 for mother-reported parenting stress and 0.909 for father-reported parenting stress; these values were significant at $p < 0.001$.

3.1.3 Interparental relationship problems

The fit statistics for mother-reported and father-reported interparental relationship problems were good (for both models: RMSEA=0.000, CFI=1.000, TLI=1.000, SRMR=0.000). Measurement invariance could be established across mother- and father-reported interparental relationship problems (Table 3). The omega value for interparental relationship problems was 0.819 for mothers and 0.870 for fathers (significant at $p < 0.001$).

Table 2: Measurement invariance for each dimension of children's engagement (using the modified structure).

	RMSEA (<.08)	CFI (>.90)	TLI (>.90)	SRMR (<.08)	ΔCFI (<.01)
Behavioral Engagement					
Configural	0.08	0.988	0.964	0.033	
Metric	0.035	0.996	0.993	0.104	0.008
Scalar	0.021	0.998	0.998	0.118	0.002
Cognitive Engagement					
Configural	0.014	1.0	0.999	0.019	
Metric	0.0	1.0	1.0	0.062	<0.001
Scalar	0.0	1.0	1.0	0.073	<0.001
Emotional Engagement					
Configural	0.0	1.0	1.0	0.015	
Metric	0.0	1.0	1.0	0.102	<0.001
Scalar	0.016	0.999	0.999	0.089	0.001
Agentic Engagement					
Configural	0.0	1.0	1.0	0.023	
Metric	0.0	1.0	1.0	0.13	<0.001
Scalar	0.0	1.0	1.0	0.164	<0.001

Table 3: Measurement invariance for parenting stress, interparental relationship problems, and parents' self-reported health.

	RMSEA	CFI	TLI	SRMR	ΔCFI
Parenting Stress					
Configural	0.000	1.000	1.000	0.012	
Metric	0.000	1.000	1.000	0.021	<0.001
Scalar	0.076	0.996	0.996	0.035	0.004
Interparental relationship problems					
Configural	0.000	1.000	1.000	0.000	
Metric	0.000	1.000	1.000	0.037	<0.001
Scalar	0.056	0.989	0.984	0.074	0.011
Parents' self-reported health					
Configural	0.000	1.000	1.000	0.055	
Metric	0.000	1.000	1.000	0.092	<0.001
Scalar	0.000	1.000	1.000	0.104	<0.001

3.1.4 Parents' self-reported health

The CFA on mothers' and fathers' self-reported health did not have acceptable model fit (mother: RMSEA=0.115, CFI=0.855, TLI=0.783, SRMR=0.070; father: RMSEA=0.125, CFI=0.835, TLI=0.752, SRMR=0.079). According to

modification indices, adjustments to the model were made. The residual variance of the item *Since I homeschooled my child, my health was more affected than usual or I had more aches and pains than I have under normal circumstances* was allowed to correlate with the residual variance of the item *I never felt my health was good*. In addition, the

residual variance of the item *I feel that my health is good most of the time* was allowed with the residual variance of the item *I noticed changes in my sleep system*. These modifications resulted in acceptable model fit (mother: RMSEA=0.000, CFI=1.000, TLI=1.000, SRMR=0.051; father: RMSEA=0.000, CFI=1.000, TLI=1.000, SRMR=0.060). Measurement invariance could be established across mothers' and fathers' self-reported health (Table 3). The omega value for parents' self-reported health was 0.757 for mothers and 0.770 for fathers (significant at $p < 0.001$).

3.2 Associations between parenting stress and children's engagement: The role of risk and protective factors

3.2.1 Mother-reported parenting stress

The results of the first model (testing for main effects of parenting stress on children's engagement and for main effects of the risk/protective factors on parenting stress and on children's engagement) can be found in Table 4 (Model 1). Contrary to our hypothesis, no significant associations between parenting stress and children's engagement were found. For mother-reported child engagement, no significant main effects were found for the associations between parenting stress and children's engagement. With regard to other significant main effects in the models, it was found that higher interparental relationship problems were related to lower cognitive engagement. Higher child liking of at-home education (an engagement-fostering type of student motivation) was associated with higher cognitive and emotional engagement, but only in the model with child-reported child engagement. In addition, a larger online social network (protective factor) was associated with lower levels of self-reported parenting stress. Contrary to our expectations, more support from school (protective factor) was associated with higher levels of parenting stress. These significant associations and their direction were found in the model with mother-reported child engagement and the model with child-reported child engagement alike.

The second model in Table 4 added interactive effects (Model 2). With regard to interactive effects, the interaction between parenting stress and child liking of at-home education (an engagement-fostering type of student motivation) was significant for all four academic engagement dimensions, when child engagement was reported by the mother. Table 5 shows the simple slopes for each child engagement dimension and the region of significance, i.e., the value of parenting stress when the

difference between the slopes loses significance. The plots of the significant interactive effects are shown in Figure S1a in the online supplement. For each dimension of engagement, the optimal level of engagement was achieved with a combination of lower parenting stress and higher child liking of homeschooling.

The pattern of significant interactive effects was different when child-reported child engagement was included in the model. Length of homeschooling (risk factor) emerged as a significant moderator of the association between mother-reported parenting stress and the behavioral, cognitive, and emotional engagement dimensions (Figure S1b in the online supplement; Table 5). With longer length in homeschooling, higher parenting stress was related to lower levels of engagement whereas with shorter length in homeschooling, higher levels of behavioral and emotional engagement were detected despite high levels of stress.

3.2.2 Father-reported parenting stress

The results of the first model (testing for main effects of parenting stress on children's engagement and for main effects of the risk/protective factors on parenting stress and on children's engagement) can be found in Table 6 (Model 1). A significant negative association between father-reported parenting stress and children's behavioral and emotional engagement was found when father-reported child engagement was included in the model. However, no such associations were found when child-reported child engagement was included. Contrary to our expectations, the father's self-reported health problems (risk factor) were negatively associated with parenting stress, a finding that was consistent for both the father- and the child-reported child engagement models. An additional risk factor, i.e., the number of children homeschooled, showed a significant association with parenting stress in the expected (positive) direction, but only in the model with father-reported child engagement. In the same model (father-reported child engagement), significant positive associations were found between two supportive factors, i.e., father's self-reported satisfaction with school support and intensity of online social network content management related to at-home education, and father-reported child emotional engagement. The model for child-reported child engagement showed that the size of the father's online social network (protective factor) was positively associated with child-reported academic engagement.

Table 4: Children's engagement during at-home education in the context of the COVID-19 pandemic: Main and interactive effects with mother-reported parenting stress.

	Mother-reported parenting stress ^a	Model 1: Mother-reported child engagement: Main effects model ^a				Model 2: Mother-reported child engagement: Main and interactive effects ^a			
		Behavioral Engagement	Cognitive Engagement	Emotional Engagement	Agentic Engagement	Behavioral Engagement	Cognitive Engagement	Emotional Engagement	Agentic Engagement
Mother-reported parenting stress		0.00 (0.04)	-0.15 (-0.28)	-0.12(- 0.02)	-0.01 (-0.01)	0.02 (-0.04)	-0.13 (-0.34*)	-0.10 (-0.11)	0.01 (-0.05)
Interparental relationship problems	-0.32 (-0.36)	-0.29 (0.24)	-0.34* (0.01)	-0.26 (0.01)	-0.19 (0.13)	-0.24 (0.13)	-0.31* (- 0.09)	-0.23 (-0.12)	-0.17 (0.07)
Child liking of at-home education	-0.06 (-0.06)	0.33 (0.35*)	0.36 (0.33*)	0.33 (0.31*)	0.21 (0.18)	0.41* (0.43*)	0.43* (0.39*)	0.40* (0.40*)	0.29 (0.24)
Risk Factors									
Parent health problems	-0.23 (-0.22)	0.21 (0.04)	0.15 (0.00)	0.25 (0.23)	0.28 (0.16)	0.17 (0.07)	0.12 (0.03)	0.22 (0.25)	0.25 (0.19)
Number of children homeschooled	0.18 (0.18)	0.12 (0.21)	0.14 (0.00)	0.16 (-0.02)	0.09 (-0.16)	0.06 (0.23)	0.09 (0.01)	0.12 (0.00)	0.05 (-0.15)
Length of homeschooling	0.03 (0.02)	-0.22 (-0.18)	-0.24 (-0.17)	-0.15(- 0.20)	-0.14 (-0.31)	-0.22 (-0.19)	-0.24 (-0.17)	-0.16 (-0.19)	-0.14 (-0.31)
Protective Factors									
Resources for at-home education	-0.17 (-0.17)	0.05 (0.03)	0.04 (-0.21)	-0.02(- 0.04)	-0.08 (0.09)	0.02 (0.01)	0.01 (-0.22)	-0.05 (-0.07)	-0.10 (0.07)
School support for at-home education	0.32* (0.31*)	0.06 (0.00)	0.13 (0.07)	0.12 (0.02)	0.13 (0.03)	0.14 (0.05)	0.20 (0.12)	0.19 (0.09)	0.19 (0.05)
Satisfaction with school support	-0.15 (-0.13)	0.19 (0.04)	0.20 (-0.01)	0.25 (0.12)	0.17 (-0.05)	0.08 (0.03)	0.11 (-0.02)	0.15 (0.10)	0.09 (-0.05)
Online Social Network									
Size of online social network	-0.27* (-0.27*)	0.00 (0.11)	-0.07 (-0.19)	-0.06 (0.09)	-0.02 (-0.09)	-0.14 (0.08)	-0.19 (-0.20)	-0.18 (0.05)	-0.13 (-0.10)
Frequency of Facebook use	-0.16 (-0.17)	-0.04 (0.07)	-0.05 (-0.11)	-0.05 (0.05)	0.10 (-0.01)	-0.02 (0.12)	-0.04 (-0.05)	-0.04 (0.13)	0.11 (0.02)
Intensity of content management related to at-home education	-0.03 (-0.02)	0.14 (0.04)	0.25 (0.28)	0.17 (0.24)	0.13 (0.28)	0.08 (0.04)	0.20 (0.26)	0.012 (0.22)	0.09 (0.29)
Interaction terms									
Mother-reported parenting stress X Child liking of at-home education ^b						-0.55* (--)	-0.44* (--)	-0.49* (--)	-0.43* (--)
Mother-reported parenting stress X Length of homeschooling ^c						-- (-0.29*)	-- (-0.29*)	-- (-0.38*)	-- (-0.14)

Note. Models control for child age. ^aResults from the model with child-reported child engagement in parentheses. ^bOnly in the model with mother-reported child engagement. ^cOnly in the model with child-reported child engagement. Bolded numbers reflect the conventional level of significance: $p < .05$, with Asterix the level of significance is indicated after the Bonferroni alpha correction: $p < .0125$.

Table 5: Simple slopes and region of significance for significant moderators of the association between mother-reported parenting stress and child engagement.

Moderator	Child engagement dimension							
	behavioral		cognitive		emotional		agentic	
	slope	p-value	slope	p-value	slope	p-value	slope	p-value
Model using mother-reported parenting stress and mother-reported child engagement								
Child liking of at-home education								
high	-1.10	<.001	-.1.25	<.001	-1.14	<.001	-0.61	.006
low	1.18	<.001	0.66	.015	0.73	.004	0.64	.009
Region of significance: Parenting stress ^a	>.20		>-.10		>.20		>.10	
Model using mother-reported parenting stress and child-reported child engagement								
Length of homeschooling								
high	-0.62	.080	-1.44	<.001	-1.13	.004		
low	0.51	.057	-0.00	.991	0.67	.018		
Region of significance: Parenting stress ^a	-.50 < x < .50		-.50 < x < .50		>.20			
Model using father-reported parenting stress and child-reported child engagement								
Child liking of at-home education								
high	-0.81	.041			-0.80	.018		
low	0.29	.047			0.30	.270		
Region of significance: Parenting stress ^a	>.20				>.00			

Note. Value of parenting stress when the difference between the slopes is not significant using Bonferroni alpha correction: $p < 0.0125$.

Next, interactive effects were added to the main effects models. The results of the trimmed model (i.e., model that includes only significant interaction terms) showed no significant interactive effects when father-reported child engagement was included. The model for child-reported child engagement showed significant interactions between father-reported parenting stress and child liking of at-home education with regard to behavioral and emotional engagement (Table 6, Model 2 and Figure S2 in the online supplement). The interaction showed that optimal child engagement was achieved by combining higher levels of child liking homeschooling and lower parenting stress. Table 5 shows the simple slopes for each child engagement dimension and the region of significance, i.e., the value of parenting stress when the difference between the slopes loses significance.

4 Discussion

The COVID-19 pandemic has had an unprecedented effect on the delivery of education. The sudden suspension of in-person educational activities and the shift to at-home

education due to the closure of schools radically changed the context for and nature of educational interactions that shape children’s engagement. Past research has highlighted the function of engagement “as a student-initiated pathway to positive educational outcomes” and confirmed its critical role for children’s academic progress (Reeve, 2013, p. 591). It is therefore important to understand children’s engagement with remote learning activities to provide the support they need to successfully continue their education amidst the educational emergency caused by the COVID-19 pandemic. Because parents were expected to take over an additional role, that of being a teacher for their child, the situation added burdens on parents which have increased parenting stress (Russell et al., 2020). The present study ought to extend the literature investigating the consequences of the COVID-19 pandemic on children’s education by examining parenting stress as a potential family process which may explain possible disparities in learning outcomes as a result of the pandemic.

Contrary to our expectations, we did not find evidence for direct associations between parenting stress and children’s academic engagement in our data. It is possible that the lack of significant associations in our

Table 6: Children's engagement during at-home education in the context of the COVID-19 pandemic: Main and interactive effects with father-reported parenting stress.

	Father-reported parenting stress ^a	Model 1: Father-reported child engagement: Main effects model ^a				Model 2: Child-reported child engagement: Main and interactive effects ^b			
		Behavioral Engagement	Cognitive Engagement	Emotional Engagement	Agentic Engagement	Behavioral Engagement	Cognitive Engagement	Emotional Engagement	Agentic Engagement
Father-reported parenting stress		-0.61* (-0.07)	-0.36 (-0.05)	-0.49* (-0.06)	-0.33 (-0.15)	-0.21	-0.14	-0.19	-0.28
Interparental relationship problems	-0.36 (-0.37)	0.01 (0.13)	-0.29 (-0.07)	-0.23 (-0.13)	-0.17 (-0.00)	0.19	-0.02	-0.06	0.06
Child liking of at-home education	0.10 (0.11)	0.28 (0.35)	0.31 (0.29)	0.20 (0.23)	0.16 (0.08)	0.40*	0.35	0.31	0.17
Risk Factors									
Parent health problems	-0.24* (-0.25*)	-0.05 (0.02)	0.08 (-0.04)	0.05 (0.09)	-0.01 (0.20)	-0.07	-0.10	-0.00	0.11
Number of children homeschooled	0.29* (0.28)	0.14 (0.23)	-0.15 (-0.06)	-0.02 (-0.08)	-0.19 (-0.17)	0.26	-0.02	-0.02	-0.11
Length of homeschooling	-0.00 (0.02)	-0.15 (-0.16)	-0.22 (-0.31)	-0.05 (-0.24)	-0.37 (-0.32)	-0.07	-0.26	-0.16	-0.26
Protective Factors									
Resources for at-home education	0.21 (0.20)	-0.01 (0.03)	0.04 (-0.09)	0.05 (0.10)	0.15 (0.18)	-0.06	-0.14	0.02	0.11
School support for at-home education	0.12 (0.13)	0.21 (0.00)	0.21 (0.07)	0.18 (0.04)	-0.03 (0.05)	0.16	0.17	0.18	0.19
Satisfaction with school support	-0.10 (-0.10)	0.23 (0.15)	0.23 (0.23)	0.32* (0.23)	-0.03 (0.02)	0.12	0.23	0.22	0.01
Online Social Network									
Size of online social network	0.08 (0.09)	-0.15 (0.16)	-0.07 (0.13)	-0.06 (0.14)	0.19 (0.27*)	0.13	0.11	0.12	0.25
Frequency of Facebook use	-0.01 (-0.03)	0.02 (-0.10)	-0.16 (-0.17)	-0.22 (-0.23)	-0.31 (-0.24)	-0.02	-0.11	-0.15	-0.16
Intensity of content management related to at-home education	0.03 (0.03)	0.08 (0.17)	0.13 (0.13)	0.32* (0.27)	0.25 (0.26)	0.09	0.08	0.20	0.19
Interaction terms									
Father-reported parenting stress X Child liking of at-home education						-0.35*	-0.22	-0.32*	-0.30

Note. Models control for child age. ^aResults from the model with child-reported child engagement in parentheses. ^bOnly the results for the model with child-reported child engagement are reported because no significant interaction terms were detected in the model with father-reported child engagement. Bolded numbers reflect the conventional level of significance: $p < .05$, with Asterix the level of significance is indicated after the Bonferroni alpha correction: $p < .0125$.

data may be due to the time when the study measures were administered. While we believe that it was important to explore the role of parenting stress for children's engagement early in the pandemic (data was collected

in May 2020, a few weeks into the pandemic), it is likely that family stress processes take time to culminate in child adjustment problems. Results could have been different at a different point during the COVID-19 pandemic. One

study from England, for example, found that while parents viewed homeschooling as an opportunity the first time when schools were closed during the pandemic, a year later, they reported being overwhelmed and stressed upon the announcement of another school closure (Mikuska et al., 2021). However, there were also cross-sectional studies conducted in different countries (e.g., Italy, Spain) that found links between parenting stress and child adjustment problems already early in the pandemic, during the period of initial school closures in April and May 2020 (Gianotti et al., 2021; Romero et al., 2020; Spinelli et al., 2020). These findings point to parenting stress being an important risk factor of adjustment problems (Romero et al., 2020). By now, many school-aged children and their parents transitioned from in-person to at-home education (and back) often more than once. Thus, the increased burdens that many families experience may have, over time, depleted their psychological and relational resources that they might still have had early in the pandemic but not after one year of crisis. Thus, it is important that research investigates the long-term consequences of school closures on children's engagement to better understand the possible deleterious effects of the pandemic due to family stress processes.

However, our findings suggest that parenting stress might relate to children's academic engagement when considered in combination with other factors, thus emphasizing the need to look for risk or protective factors that might underline or undermine the negative impact of the emergency homeschooling situation. Indeed, research on parenting stress during the COVID-19 pandemic suggests that associations between parenting stress and child outcomes are "not always based on direct effects" (Romero et al., 2020, p. 16). In our data, a type of engagement-fostering student motivation, i.e., child liking of at-home education, was such a factor. When parenting stress was low, children who enjoyed the remote learning activities at home scored higher on different engagement dimensions compared to children who did not enjoy being homeschooled. This is in line with prior theoretical and empirical evidence demonstrating that student motivation and interest foster their academic engagement (Reeve, 2013; Reeve & Lee, 2014). Interestingly, when parents reported high levels of perceived parenting stress, children's academic engagement did not differ for high or low levels of child liking of at-home education. Thus, high motivation did not buffer against the potential negative effects of parenting stress on children's adjustment to remote learning. For children who enjoyed the remote learning activities at home, engagement was lower. For children who did not enjoy being homeschooled, their engagement scores were higher when parenting stress

was high compared to when parenting stress was low. It is possible that high parenting stress may lead parents to take over and control the homeschooling situation, not allowing their child to independently engage with remote learning activities. Although the interaction plots (Figures S1a and S2 in the online supplement) suggest that children who are less motivated might benefit from their parents controlling their participation, effort, and attention in the learning activities, it is important to point out that the long-term consequences of high levels of parenting stress are detrimental to children's development (Masarik & Conger, 2017). Prior research has shown that higher levels of parenting stress are associated with inconsistent or harsh parenting practices which in turn are linked to children's behavioral, social-emotional and academic problems (Chang, Schwartz, Dodge, & McBride-Chang, 2003; Deater-Deckard, Wang, Chen, & Bell, 2012). Importantly, parenting is a complex bidirectional process. Children who experience their parents taking over and controlling the homeschooling situation might lose their initial enjoyment of the at-home education which leads to lower engagement that may then further increase the parent's parenting stress. To better understand educational trajectories, it is, therefore, critical to investigate the reciprocal effects between children's and parent's responses to the pandemic.

A second factor that moderated the relationship between parenting stress and children's engagement was the length of homeschooling, however, only when mother-reported parenting stress was considered. In our sample, mothers were primarily responsible for homeschooling. This is consistent with the literature documenting that upbringing has fallen disproportionately on the shoulders of mothers, prior to and, even more so, during the pandemic (Collins, Landivar, Ruppanner, & Scarborough, 2020; Rhubart, 2020). We found that when mothers reported high parenting stress, children's engagement was lower when homeschooling lasted longer compared to when it lasted for fewer weeks. As the burdens related to at-home education are likely to increase with the length of imposed school closure, mothers might perceive parenting as more stressful. The depletion of resources during longer periods of at-home education might result in mothers being less supportive which may be related to the lower extent to which their child engages in learning activities at home. However, it is important to note that our results reflect cross-sectional data which prevents conclusions regarding temporal relationships between at-home education, parenting stress, and children's academic engagement. In addition, only few interactions were significant after applying the

Bonferroni alpha correction. Thus, the interpretation of our findings remains speculative and further research is needed to investigate the role of family stress processes for children's academic engagement in the context of emergency at-home education.

4.1 Strengths and limitations of the present study

This study had multiple strengths, including (a) the focus on children's academic engagement which adds an important learning outcome to the fast-growing body of research on the pandemic's effects on children; (b) a multi-informant approach for the measurement of children's academic engagement whereas prior research on child outcomes during the pandemic has often relied on parents' reports; and (c) the inclusion of the perspectives of mothers and fathers regarding their perceived parenting stress, interparental relationship problems and health problems while most prior studies relied on single informant information (often mothers). Together, this study makes a timely, initial contribution to understanding the context for children's academic engagement in remote learning activities during the unprecedented COVID-19 pandemic as we only begin to understand the effects of transitioning from in-person to home-based, remote learning. It can help to generate testable new hypotheses for future studies of children's academic engagement in conditions of acute and persistent crises.

However, the study also had important limitations. A major limitation is that we were, due to the sudden crisis, unable to assess the variables of interest before the outbreak of the COVID-19 pandemic. Although this limitation applies to many studies on the effects of the pandemic on children's outcomes, without pre-pandemic measures we cannot disentangle pre-existing individual differences that contribute to children's engagement within the context of at-home education from aspects that are more likely attributable to experiencing the conditions of at-home education themselves. The cross-sectional nature of the data thus precludes causal inferences. Additional limitations are related to the recruitment method. Because prior research has shown that parents use social media for social support in challenging situations (Bartholomew et al., 2012), advertisements on Facebook were used to recruit participants. Facebook is the most regularly used social media website in the US in 2020 (Statista, 2020). However, it is important to point out that the usage of social media is higher among adults with higher levels of education (Statista, 2021). It is also possible that participants

responded to the advertisement solely because of the hopes of receiving the Amazon voucher. Although the first author's university's IRB approved the voucher as appropriate compensation for participation, undesired influences on the results cannot be ruled out. An additional limitation was the small sample size afforded limited power, in particular, in regard to the complexity of the path model. In an attempt to address this point, we used exported factor scores instead of modeling latent variables in the path models, and applied model trimming. Finally, the shared-method variance may have contributed to some of the associations that were documented, in particular in the models when the parent reported on parenting stress, risk/protective factors, and child engagement themselves. To address this point, we included child-reported child engagement, yet, the sample of children was small. The instrument used to assess child engagement was previously used with older children. It might have been challenging for the younger children in our sample to respond to the questions although similar measures of child engagement were used with children as young as in our sample (e.g., Pietarinen, Soini, & Pyhältö, 2014; Wang, Bergin, & Bergin, 2014). However, future research would be advanced by incorporating reports on children's outcomes from other sources, for example, teachers.

4.2 Conclusion

The closure of schools in Spring 2020 due to the COVID-19 pandemic sparked an unprecedented change in the delivery of education to millions of school-aged children worldwide. The current study provides a one-time snapshot of parents' perceived parenting stress in relation to children's academic engagement in remote learning activities early in the pandemic. Parents', in particular, mothers', self-reported parenting stress was related to children's academic engagement when considered in combination with other factors. More specifically, variation in the extent to which the child enjoyed the at-home education and the length of homeschooling may explain variation in the association between parenting stress and children's academic engagement. Thus, our study identified potential risk and protective factors of children's academic engagement which may present implications for services aimed to enhance children's academic functioning during the ongoing crisis. Moreover, as the pandemic continues, it may also be important to promote positive stress management to support parents in helping their children to regulate and maintain their engagement in remote learning activities.

Funding Information: The study was supported by New York University Abu Dhabi Faculty Research Funds to Antje von Suchodoletz.

Author contribution: The authors applied the SDC approach for the sequence of authors.

AvS: Conceptualization, Methodology, Investigation, Resources, Data Curation, Writing - Original Draft, Writing - Review & Editing, Supervision, Project Administration, Funding Acquisition

SF: Formal Analysis, Data Curation, Visualization, Writing - Review & Editing

RAL: Writing - Review & Editing, Supervision

Conflict of Interest: The authors state no conflict of interest.

Data Availability Statement: The dataset generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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