



Negative Impacts of Pandemic Induced At-Home Remote Learning Can Be Mitigated by Parental Involvement

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Format changes in U.S. schooling in response to the COVID-19 pandemic varied by month and by school district, ranging from exclusively home-based to full in-person learning. The impact of these changes on adolescent schooling experiences, and the factors that mitigate such impact, have been challenging to quantify. To address these challenges we employed bi-monthly repeated surveys of youths ($N = 6,546$, aged 13–14 years) in a longitudinal study, starting before the pandemic peak (October 2020) and continuing through one year after the pandemic was declared (March 2021). We investigated how school format (in-person vs. remote) impacted objective time spent on academic activities and the subjective experience of school, and how these were influenced by parental engagement. Periods of exclusive at-home remote schooling were pervasive—reported by more than 60% of youths—and linked to a reduction in school enjoyment and time spent on reading, math, and science. In contrast, such periods were linked to more time with parents or guardians helping with school activities, and the frequency of such parental involvement was associated with reductions in negative feelings about school. Results point to potential pathways to mitigate the negative consequences of future school disruptions.

Keywords: COVID-19, e-learning, parent-adolescent relations, emotion, learning activities

INTRODUCTION

In March 2020, state and local governments in the United States first began ordering or recommending school closures in response to the COVID-19 pandemic (Week, 2020b). This swift action led to a patchwork of reactionary solutions by schools across the nation in the months that followed, ranging from full closure with exclusively online classes to some schools that remained open. Initial periods of sheltering at home meant little or lower-quality instruction for many students, which impacted academic skill development in various ways, such as

accumulated learning losses in oral reading fluency that were not recovered by the fall of 2020 (Domingue et al., 2021). Suspended school operations also disrupted students' routines and access to school resources, increasing stress and exacerbating mental health issues (Lee, 2020). By the start of the 2020–2021 school year, these school closures impacted over 55.1 million students across the nation, and approximately 74% of the largest public school districts were still operating under a remote-learning-only instructional model in which students were not at a physical campus with other students and teachers (Week, 2020a). This prolonged, large-scale change to formal schooling was associated with a substantial rise in inequality amongst low-income students and their families (Dorn et al., 2020; Parolin and Lee, 2021). Specifically, low-income students and English language learners from nonwhite communities have been experiencing the brunt of these impacts on learning (Halloran et al., 2021; Pier et al., 2021). Thus, it is critical to better understand the educational impacts of in-person school closure and potential mitigating factors if we are to address and effectively remediate the negative consequences.

Although the pandemic quickly forced educators and learners into an unforeseen pivot away from in-person learning, previous studies of remote learning provide some potential insights about the impacts on schooling experiences. Unlike the current nation-wide pandemic, remote learning studies have historically addressed unique and specific segments of the population - those with special circumstances (e.g., elite athletes), geographic constraints, special learning needs, or older learners (e.g., high school, Childers and Jones, 2017; and college-level/professional school, U.S. Department of Education, 2009; Caporarello et al., 2018). Systematic investigations of the impact of remote learning on schooling experiences have focused on comparisons to traditional school settings, and investigated factors such as motivation, engagement, attention/distractions, and quantitative student learning outcomes (for reviews, see Patrick and Powell, 2009; U.S. Department of Education, 2009), yet few have addressed the in-home factors that might mitigate the downsides of remote learning.

Obviously, learning during a global crisis such as a global pandemic raises novel challenges for attempts to apply the insights from previous remote learning studies (see Moore et al., 2011; for a terminological discussion of the multiple perceptions of remote learning). Most pre-pandemic remote learning studies do capture the many challenges that learners, educators, and families faced during the school-closures, many of which still are pervasive in the face of the ongoing COVID-19 pandemic. On the educator side, teachers who had exclusively taught students in-person were thrust into online environments with little to no formal training and had to adapt rapidly without sufficient time, technology, and other necessary resources (Kaufman and Diliberti, 2021a,b). On the student side, the home lives of many were significantly impacted by factors such as shifts in employment, health struggles, space limitations, etc. imposed by the global pandemic (Brynjolfsson et al., 2020; Jiao et al., 2020; Racine et al., 2020). Such changes raise significant challenges to assessing the impact of the COVID-19 pandemic on schooling, academic achievement, and especially student experiences. State-level standardized assessments for 2021 were either not being

offered or were only available on an opt-in basis (Week, 2021), introducing new challenges for direct comparisons with previous years, and interpretation of the impact of radically different testing environments and contexts.

The current study takes a short-term longitudinal approach to address the effect of the pandemic-related disruption in schooling in a nation-wide sample. We were particularly interested in capturing dynamic changes in schooling format, and tracking how these changes relate to the subjective perception of schooling experience (i.e., positive emotions toward school), as well as more objective aspects such as the time spent on school activities and specific academic topics. In addition, we proposed that factors related to home life, such as parent's involvement in schooling, may also play a pronounced role in how some of these metrics were impacted by school format.

Our focus on positive emotions toward learning were motivated by extensive evidence on the critical role emotions play in keeping a learner engaged and motivated. Enjoying learning is important for success in both in-person and remote academic environments (Stephan et al., 2019). Enjoyment is also closely linked to interest in particular topics (Ainley and Ainley, 2011) and student emotions are important in shaping academic engagement (Linnenbrink-Garcia and Pekrun, 2011). Brubacher and Silinda (2019) found that intrinsic motivation, defined as enjoying academic work and finding it interesting, significantly predicted distance education students' intent to finish their degrees, whereas perceived academic competence did not. How students feel about school thus may be particularly important for success in distance learning contexts, as such formats likely require students to rely on intrinsic motivation to a greater extent than those attending school in-person. Previous studies on such phenomena, however, have primarily focused on courses designed for distance, not on courses that were set up by necessity resulting from a pandemic. Recent findings, collected during the pandemic, emphasized that students' satisfaction with remote learning strongly mediates the impact of learning quality (Kerzi et al., 2021). To better isolate the impact of pandemic-induced shifts to exclusive remote vs. hybrid in-person learning on emotional responses to schooling, we introduced several questions to gauge feelings about school during the school year 2020–2021.

Importantly, assessing potential negative impact of pandemic induced shifts to remote learning on schooling experience can also be investigated through more objective metrics of school engagement, such as the amount of time a student chooses to engage in various school subjects. During a pandemic disruption in education, children may have more discretion over the amount of time spent on various academic topics and schools may vary on the amount of compelling content they can provide, both of which may reflect the impact of loosening accountability associated with in-person schooling, as well as reflecting a student's intrinsic motivation. Objective measures of time spent in various schooling activities may be especially important given findings that link variations in time on school subjects to achievement and psychological development. Previous work has already established how, under typical educational circumstances, programmatic increases in

instructional time can lead to small, positive improvements in student performance (Huebener et al., 2017). For example, studies of the impact of extending a school day or a school year report improvements in both academic (e.g., GPA, standardized test scores) and non-academic, psychosocial skills (for review, see Patall et al., 2010). Similar effects have been found in studies of high-performing (Huebener et al., 2017), at-risk (Patall et al., 2010), immigrant, and low-income students (Lavy, 2015). As many studies point out, however, although duration is a readily captured object metric, such findings should not be taken to suggest that other more elusive factors that are beyond the scope of this study, such as schooling quality and optimizing instruction for learners, are not equally or more important for student learning (Gromada and Shewbridge, 2016).

Finally, we measured the effects of school setting (in-person or remote) on parents' involvement in school-related activities, and the potential impact of parental involvement on metrics of school experience. Within typical educational environments, parent involvement is already well-identified as an important factor that impacts overall student success (Jeynes, 2007; Harris and Goodall, 2008). In a meta-analysis of 50 studies, Hill and Tyson (2009) found that overall parent involvement was positively associated with student achievement, with the exception of parental help with homework. Along the same lines, Leonard et al. (2019) demonstrated that parental interference (i.e., when parents take over) during a child's productive struggle can lead children to not persevere during subsequent challenges. Additionally, parenting style (e.g., authoritative vs. democratic) and the child's perception of parental involvement can have significant impacts on the student's psychological well-being, particularly their self-esteem, as well as their intrinsic motivation for learning (Cripps and Zyromski, 2009). In the case of remote schooling precipitated by a pandemic, the nature of parental support may change dramatically—including direct pedagogical instruction (e.g., homeschooling) or pragmatic support (e.g., logging into video classes, other technical support, assisting with school schedule), and the level of parental support may have a larger impact on schooling experiences than typically observed in in-person learning settings. Thus, the question of how parental involvement differed during the pandemic, especially when contrasting periods of remote vs. hybrid/in-person learning, became a central motivating question for the design of this study, and enabled us to investigate which forms of parental involvement can help mitigate the potentially negative impact of remote learning.

In the current study, we leveraged pre-pandemic research relationships with thousands of youths who were already participating in the Adolescent Brain Cognitive DevelopmentSM (ABCD) Study (<http://abcdstudy.org>, see Jernigan et al., 2018) aged 13–14 years during the 2020–2021 school year. This age range is particularly relevant because it corresponds to the transition from middle to high school, which is known to be challenging for youth, their parents, and their teachers (Alsbaugh, 1998; Mizelle and Irvin, 2000; Akos and Galassi, 2004). Success in this transition is highly predictive of later academic achievement (Anderman, 1998).

We created a novel set of survey items, and administered the same items three times, at approximately 2 month intervals

to capture the dynamic nature of both the changes in school format and the impact it was having as students transitioned from one format to another. Such a study design provides unique affordances to characterize the evolution of school activities in the context of disrupted learning in a large sample in the US. Since most remote teaching was set up by necessity and not designed for distance learning (Kaufman and Diliberti, 2021a), we hypothesized that, in contrast to the well-established literature on distance learning, youth who were remotely schooled would enjoy school less, spend less time on structured school activities, and need more help from their parents to manage and work on their school duties. We also investigated the relationships between these dimensions. We expected dimensions to interact differently for youth in the context of attending school in person vs. the context of at-home remote schooling. Among the latter, we hypothesized that stronger parental involvement (mostly pedagogical instruction) would be an important factor in fostering more positive emotions toward school.

METHODS

Participants

Our recruitment strategy capitalized upon the family-researcher relationships already established by the ABCD Study[®] (<http://abcdstudy.org>), a multisite (21 data collection sites in 17 US states), longitudinal study that has been following minors from childhood to adolescence (Jernigan et al., 2018). Participating children were initially enrolled through their schools and communities and have been followed with comprehensive annual visits and shorter 6-monthly follow-ups (see Garavan et al., 2018). During our survey study, the ABCD youth cohort was 13–14 years old.

For the purposes of the current study, we designed and solicited three periodic responses to a novel self-report online survey that was disseminated to all youth participants at bi-monthly (i.e., approximately every other month) intervals between October 2020 and February 2021, during the COVID-19 pandemic. In total, 6,546 adolescents (mean age: 13.24 years) responded to at least one questionnaire and were included in the following analyses. Sample demographics are described in **Table 1**. Among all participating youth, 2,745 adolescents completed all three questionnaires.

Written informed consent and assent were obtained at the baseline of the ABCD Study, from a parent/guardian and the child, respectively. Participation in each of the three online surveys was optional and participants were compensated five dollars for completion of each survey. All procedures were approved by a centralized institutional review board (IRB) at the University of California, San Diego. The data from these questionnaires are available through the National Institute of Mental Health Data Archive (NDA, 2021).

COVID-19 Questionnaires

Here, we analyzed survey items related to school setting and school-related activities, including youth reports on current school setting (on-site, remote, or mixed), the amount of time spent per day on different school subjects (language arts, reading, math, science, social studies, other), parental involvement

TABLE 1 | Demographics of ABCD study participants included in the current analysis.

Variable	Count (Percentage)		
	October 20	December 20	February 21
Race/Ethnicity			
White	2,958 (60%)	2,631 (61%)	2,726 (61%)
Black	481 (10%)	397 (9%)	390 (9%)
Hispanic	816 (17%)	730 (17%)	746 (17%)
Asian	148 (3%)	140 (3%)	141 (3%)
Other/Not reported	519 (10%)	461 (10%)	487 (10%)
Sex at birth			
Male	2,430 (49%)	2,147 (50%)	2,188 (49%)
Female	2,491 (51%)	2,180 (50%)	2,275 (51%)
Unknown/Not reported	1 (0%)	0 (0%)	1 (0%)
Parental education			
< High School Diploma	159 (3%)	130 (3%)	137 (3%)
High School Diploma/GED	366 (7%)	318 (7%)	322 (7%)
Some College	1,186 (24%)	1,028 (24%)	1,052 (24%)
Bachelor's degree	1,598 (32%)	1,448 (33%)	1,477 (33%)
Post-Graduate degree	1,607 (33%)	1,398 (32%)	1,469 (33%)
Unknown/Not reported	6 (0%)	5 (0%)	7 (0%)
Yearly parental income			
< \$5,000	99 (2%)	89 (2%)	66 (1%)
\$5,000–\$11,999	99 (2%)	73 (2%)	72 (2%)
\$12,000–\$15,999	68 (1%)	63 (2%)	54 (1%)
\$16,000–\$24,999	126 (3%)	102 (2%)	108 (2%)
\$25,000–\$34,999	191 (4%)	158 (4%)	178 (4%)
\$35,000–\$49,999	289 (6%)	255 (6%)	246 (6%)
\$50,000–\$74,999	554 (11%)	509 (12%)	522 (12%)
\$75,000–\$99,999	675 (14%)	600 (14%)	621 (14%)
\$100,000–\$199,999	1,726 (35%)	1,519 (35%)	1,621 (36%)
≥ \$200,000	756 (15%)	657 (15%)	699 (16%)
Unknown/Not reported	339 (7%)	302 (7%)	283 (6%)
Mean age, in years (<i>SD</i>)	13.24 (0.86)	13.15 (0.87)	13.30 (0.86)

SD, Standard Deviation.

(assisting with school schedule, checking homework, creating activities, teaching concepts), and emotions toward school (enjoyment or feelings of missing school). The questionnaire items are available in **Appendix A**, and we discuss and provide additional analyses of their validity and reliability in **Appendix B**. Note that the school items that we investigated here were the same throughout the three questionnaires. The three questionnaires were disseminated during the school year 2020–2021: October 8, 2020 (Oct 20), December 13, 2020 (Dec 20), and February 2, 2021 (Feb 21). Expected completion time for each questionnaire was 10–15 min. Data were collected and managed using *REDCap* electronic data capture tools (Harris et al., 2009, 2019).

Demographics Data

Participants' demographic data were obtained from the baseline visit (Garavan et al., 2018; Consortium, 2020). In **Table 1**, we

report race/ethnicity for each child (note that the “Other” response choice included multiple ethnicities), and as indices of *socio-economic status* (*SES*) we report the maximum parental education level, and the yearly parent-reported annual household income (before taxes). We used the most recent available data point for each of these measures.

Statistical Analyses

Statistical analyses were conducted on nonmissing responses from youth who fully completed the survey under consideration; we further excluded “I don't know/Not reported” responses from the analyses but described such responses (i.e., percentage of each) below. To measure the main effect of school setting on emotions toward school, the amount of time spent on learning activities, and parents' involvement, we first fit several linear mixed effects models with the *lmer R* package (Bates et al., 2015), with *School Setting* (two levels: on-site vs. remote),

Timepoint (three levels corresponding to Oct 20, Dec 20, and Feb 21) and the interaction thereof as fixed effects. All outcome variables were considered as numeric variables on an ordinal scale. We considered the following demographic covariates as fixed effects: *Race/Ethnicity*, *Sex at birth*, *Parental Education*, and *Yearly Parental Income* (see **Table 1**). Each youth participant was introduced to the models as a random effect. We then ran *ANALYSES OF VARIANCE (ANOVAS)* to statistically assess whether school setting, time point, and/or their interaction significantly contributed to the prediction in each model. Degrees of freedom were estimated using the Satterthwaite approximation method (Satterthwaite, 1941).

We secondly used a first-difference approach (see Cameron and Trivedi, 2005; Wooldridge, 2010, for further methodological considerations) to characterize the potential interaction between school setting and time points on each of our variables of interest. In particular, we investigated whether changes in school setting (i.e., going from remote to on-site schooling or the other way around) would change emotions toward school, the amount of time spent on learning activities, and parental involvement. To capture the changes occurring across the whole school year, we specifically restricted our data set to the 2,745 youth who completed the three questionnaires for these analyses.

For each youth, we computed the response changes in school setting and our variables of interest from Oct 20 to Dec 20 and from Dec 20 to Feb 21. We then fit several linear models predicting changes in the variable under consideration as predicted by the school setting changes (considered here as a fixed factor). We finally reported the standardized coefficients and the statistical significance of the school setting change factor.

RESULTS

School Setting

In the current study, we considered school setting as the primary grouping factor to further investigate our variables of interest. The distribution of youth responses relative to their current school setting is described in **Table 2**.

Most respondents were remotely schooled at each of the three points (61%, 66%, and 47% of participating youth). We conducted a Chi-square test of independence, revealing that the distribution of the school setting significantly differed across the 3 months, $\chi^2(6) = 518.96, p < 0.001$. There was a significant increase from Oct 20 to Dec 20 in remote responses and other responses, $\chi^2(3) = 159.55, p < 0.001$. There was a significant decrease in remote setting and a significant increase in in-person setting from Dec 20 to Feb 21, $\chi^2(3) = 434.91, p < 0.001$.

The latter change illustrates that more schools switched to full or partial in-person learning settings in the first quarter of 2021 relative to the end of 2020.

In the following analyses, for each questionnaire, we only considered youths who responded being in a remote or in-person setting during the whole school week. We did not consider youth who reported being in a “Mixed” setting because the data set does not provide further information about the nature of such mixed settings. This category could refer to youths who spent 1 day a week in person and 4 days at home, but also youths who spent 4 days a week in person and only 1 day at home.

Emotions Toward School

Next, we investigated how much youth reported enjoying school the week prior to the survey. Response distribution as a function of school setting and time point is shown in **Figure 1**. Visual inspection of **Figure 1** indicates that respondents who went to school in-person provided more positive responses (“Quite enjoyable” and “Very enjoyable”) toward school, whereas more youth who were schooled-at-home responded negatively (“Very unpleasant” and “Quite unpleasant”).

We built a linear mixed-effect model predicting school enjoyment to assess the statistical significance of the effect of school setting over and above SES and various demographic variables (see Method). School setting had a significant effect on school enjoyment, $F_{(1,9549.9)} = 225.159, p < 0.001$. Overall, remote learning yielded more negative emotions toward school than in-person setting. Time points did not have a significant effect on enjoyment, $F_{(2,6931.9)} = 2.196, p = 0.111$. However, school setting significantly interacted with timepoint, $F_{(2,7170.5)} = 6.947, p < 0.001$. We looked at the changes across the three time points with a first-differenced approach to investigate this interaction (see Methods). We observed that changes in school setting significantly predicted changes in emotions ($\beta = 0.35, p < 0.001$), with more positive emotions toward school when transitioning from remote to in-person settings.

Time Spent on Learning Activities

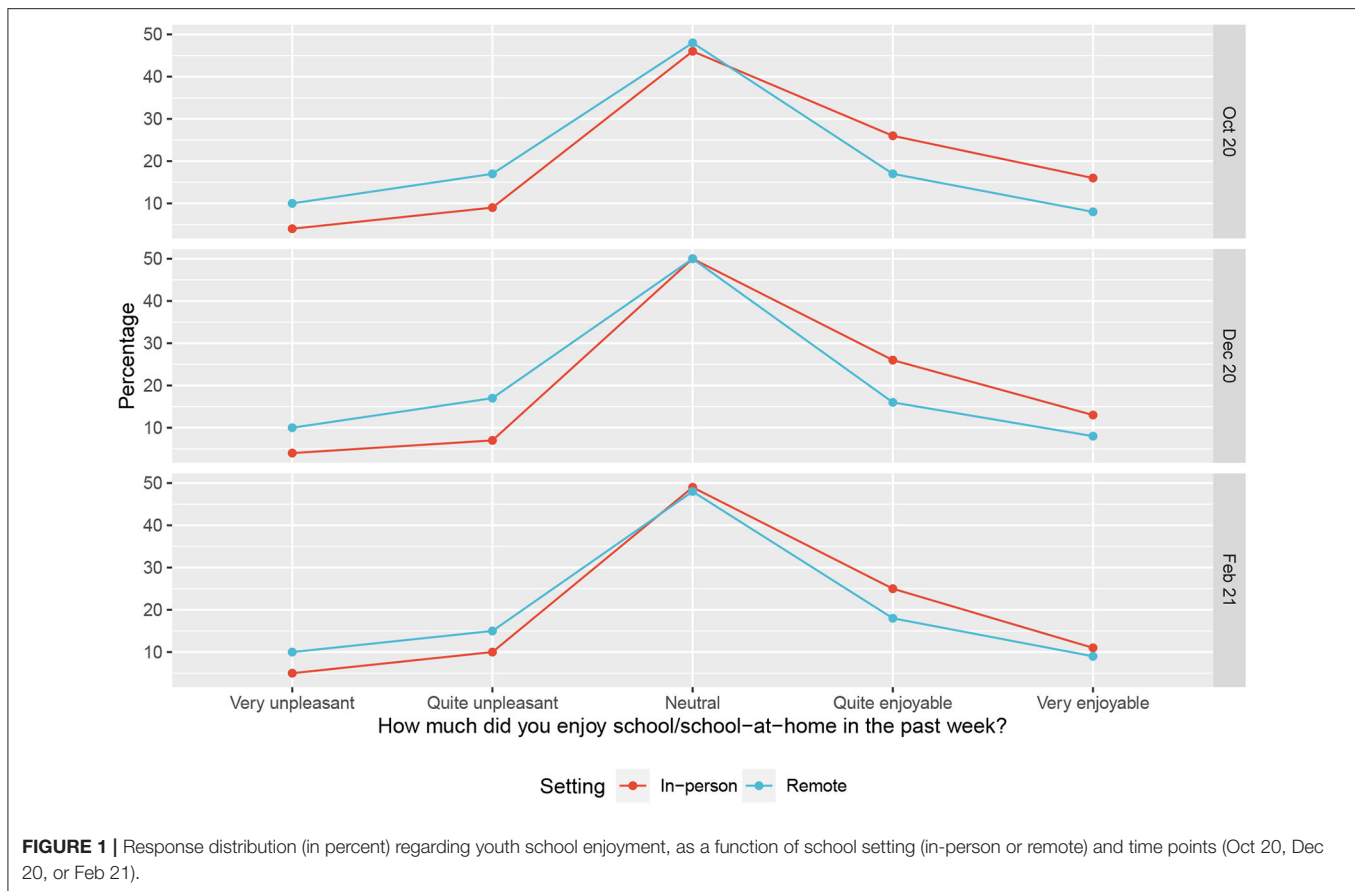
Here, we investigated whether youth spent their school time differently on several subjects as a function of their school setting. Response distribution as a function of school setting across the three time points is shown in **Figure 2**. Across the three surveys, 2.41% of responses were unspecified, and we excluded them.

Linear mixed-effect models revealed that school setting significantly impacted the time youth spent on learning activities. Youth schooled remotely spent less time than their on-site peers schooled in language arts, $F_{(1,8447.2)} = 42.646, p < 0.001$, social

TABLE 2 | Distribution of response choices to the question: “In the past week, was your schooling taking place:”

Survey	Remote	In-person	Mixed	Other
October 2020	2,983 (61%)	846 (17%)	990 (20%)	100 (2%)
December 2020	2,846 (66%)	647 (15%)	583 (13%)	247 (6%)
February 2021	2,099 (47%)	1133 (25%)	1,097 (25%)	133 (3%)

“Mixed” here refers to the choice “In person some days and online some other days”.



studies, $F_{(1,8461.3)} = 38.307, p < 0.001$, math, $F_{(1,8440.4)} = 53.434, p < 0.001$, science, $F_{(1,8377.7)} = 76.374, p < 0.001$, reading, $F_{(1,8344.6)} = 18.635, p < 0.001$, and other learning activities, $F_{(1,8578.1)} = 41.785, p < 0.001$. Timepoint did not significantly impact time spent on language arts, $F_{(2,7145.1)} = 1.726, p = 0.178$, math, science, and other activities (all $F < 1$). Nonetheless, time point did affect the time spent on reading and learning social studies, $F_{(2,7297.6)} = 11.402, p < 0.001$ and $F_{(2,7243.9)} = 3.31, p < 0.036$, respectively, with more time spent on both activities at the beginning of the school year. Notably, there was no significant interaction between school setting and time points for any learning activities, all $p > 0.10$. The response distribution as a function of time points is shown in **Appendix C1**.

Although we did not find a significant interaction between school setting and time points, we still investigated whether changes in school setting would predict changes in time spent on these activities. We found that changes in school setting significantly predicted changes in time spent on language arts ($\beta = 0.18, p < 0.001$), social studies ($\beta = 0.17, p = 0.001$), math ($\beta = 0.18, p < 0.001$), science ($\beta = 0.18, p < 0.001$), reading ($\beta = 0.12, p = 0.013$), and other activities ($\beta = 0.19, p < 0.001$). The pattern of results was similar across activities, in a way that transitioning from remote to in-person

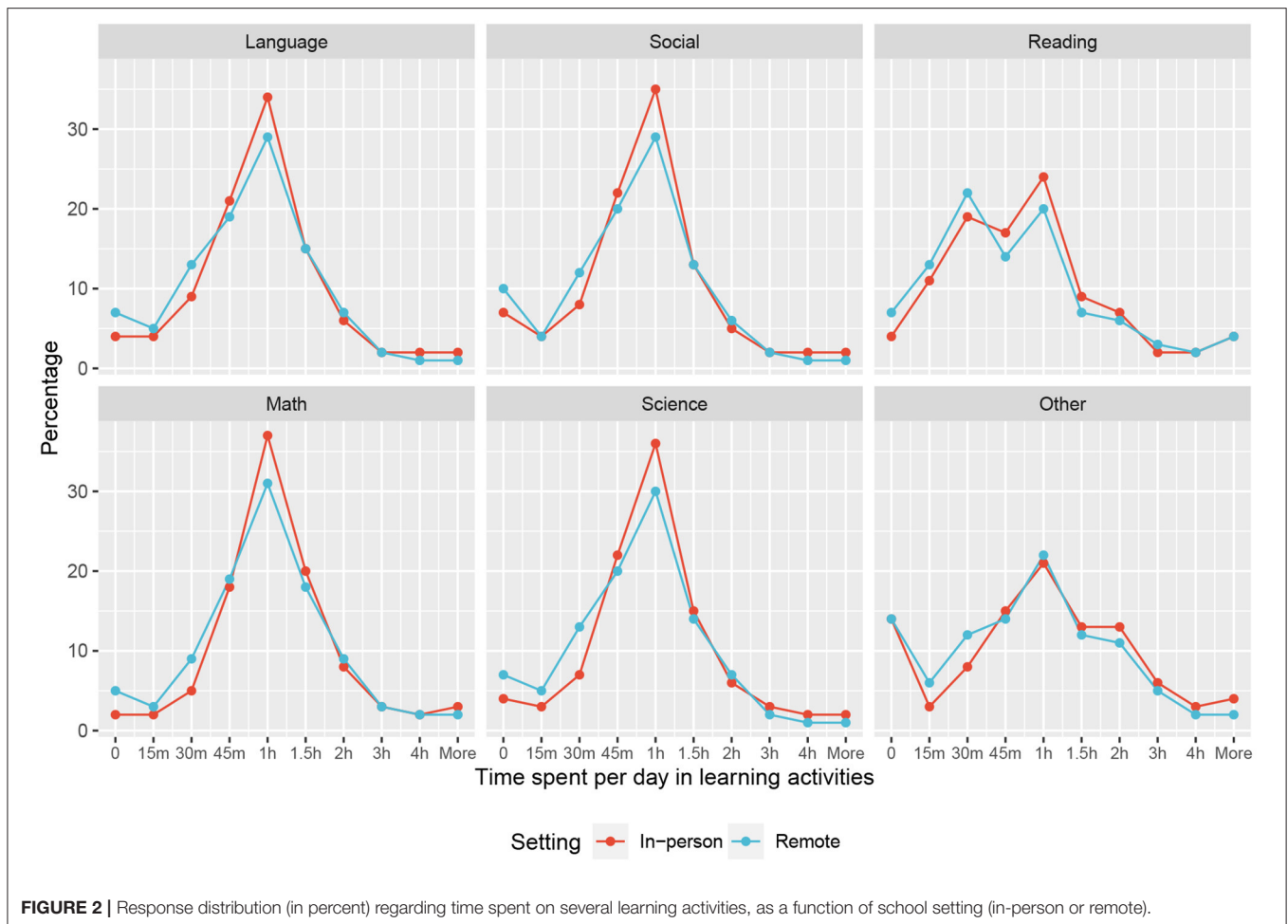
settings was associated with more time spent on all considered activities.

Parental Involvement

We assessed youth self-assessment of parental involvement with respect to their school duties. It is worth noting that parental involvement is not limited to monitoring youth work (e.g., checking homework) but also comprises parents' engagement in assisting with scheduling, creating new assignments and activities, and directly teaching concepts. Response distributions as a function of school setting across the three time points are shown in **Figure 3**. In total, 2.81% of responses were unspecified and thus excluded from the following analyses.

Linear mixed-effect models revealed that school setting significantly impacted parental involvement. Parents of children who were remotely schooled were reported as spending more days checking homework, $F_{(1,6419.7)} = 8.687, p < 0.001$, assisting with managing school schedule, $F_{(1,6111.5)} = 16.079, p < 0.001$, creating new learning activities, $F_{(1,6320.3)} = 14.082, p < 0.001$, and teaching concepts, $F_{(1,6475.7)} = 16.269, p < 0.001$.

Additionally, time point did significantly affect parental involvement too, with more days spent by parents in checking homework, $F_{(2,4556.3)} = 17.513, p < 0.001$, assisting with managing school schedule, $F_{(2,4776)} = 8.358, p < 0.001$, creating new learning activities, $F_{(2,4623.5)} = 4.805, p = 0.008$, and



teaching concepts, $F_{(2,4469.3)} = 12.973, p < 0.001$, at the beginning of the school year across both schooling groups. There was no significant interaction between school setting and timepoint impacting parental involvement, smallest $p = 0.059$. The response distribution as a function of time points is shown in **Appendix C2**.

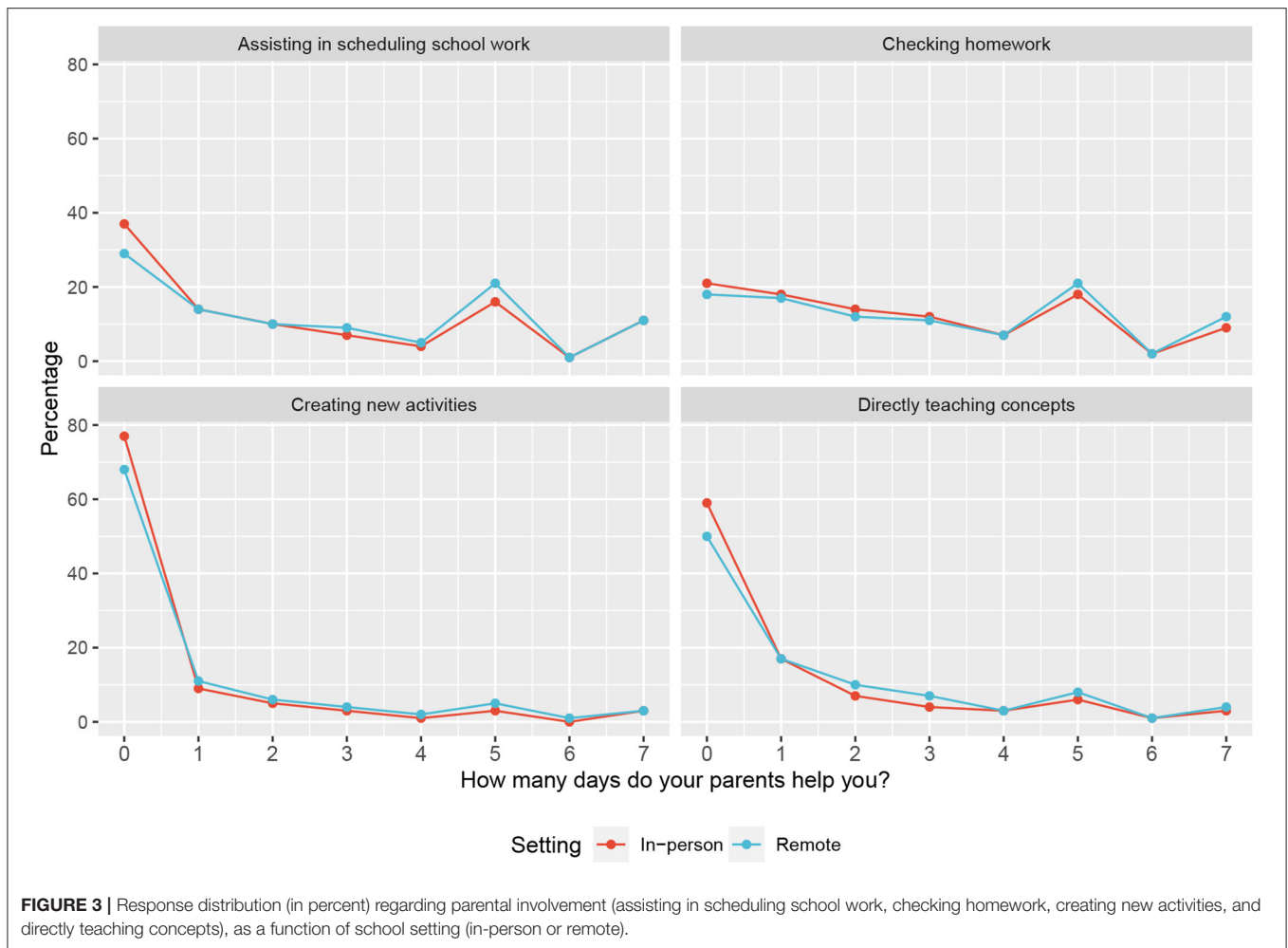
Regarding the relationship between changes in school setting and changes in parental involvement, we did not find any significant effects. In particular, checking homework ($\beta = 0.04, p = 0.618$), assisting with scheduling ($\beta = 0.01, p = 0.868$), creating assignments ($\beta = 0.10, p = 0.674$), and teaching concepts ($\beta = 0.13, p = 0.169$) were not influenced by changes in school settings. This finding may reflect the fact that parental involvement was relatively stable across the three time points of the study, with parents not adjusting their involvement as schools returned to increased in-person learning.

Correlations Within School Environment

In this section, we separately analyzed the relationships between our variables of interest within in-person schooled youth and within remotely schooled youth. Pearson correlation coefficients (across all time points) are shown in **Figure 4**. In both groups, time spent on a given activity significantly correlated with time

spent on any other activity, smallest $r = 0.17, p < 0.001$, and measures of parental involvement significantly correlated between each other, smallest $r = 0.30, p < 0.001$. School enjoyment also correlated with time spent on reading in both groups, $r = 0.09, p < 0.001$, and $r = 0.04, p = 0.005$. More reading time (including but not limited to academic reading) was thus positively associated with more positive emotions toward school.

We found several significant correlations within youth who were in a remote school setting. First, in this group, time spent on other learning activities was negatively associated with reports of parental involvement, smallest $|r| = 0.04, p = 0.002$. In other words, youth who spent more time on undefined school activities reported that their parents spent less time managing, helping or monitoring their school duties. Secondly, school enjoyment significantly correlated with parental involvement within youth who were schooled in a remote setting, smallest $r = 0.06, p = 0.003$, whereas youth schooled in-person did not show this association. This means that remotely schooled youth who reported that their parents were more involved in their learning activities had more positive emotions toward their schooling experience than youth who did not report getting support or supervision from their parents.



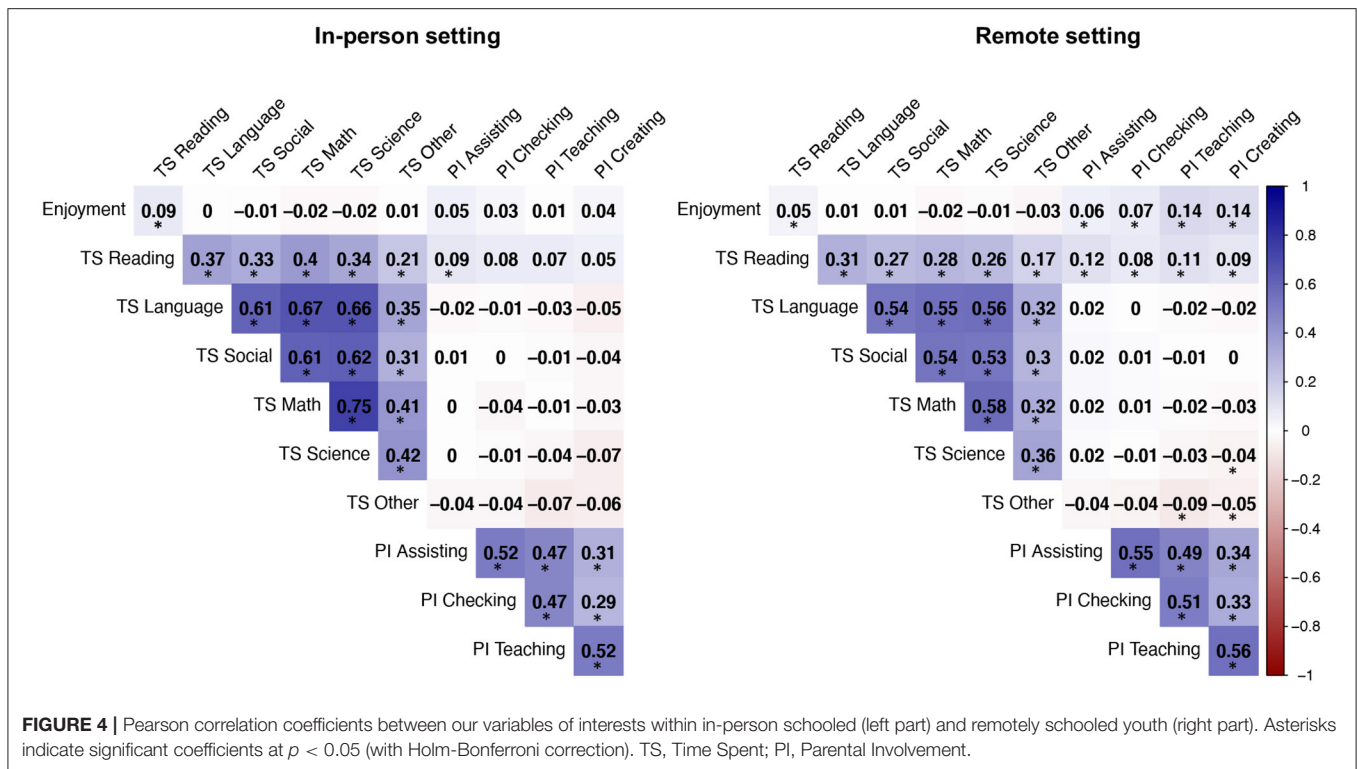
DISCUSSION

More than 1 year after the onset of the pandemic, the impact of remote schooling was investigated in a national diverse sample of youth. This study attempted to better characterize the nature of these remote schooling environments, specifically related to student enjoyment, time spent on school-related activities, and the extent of parental involvement. Overall, we found that youth who were remotely schooled reported enjoying school less, spent less time on school activities, and received more parental monitoring on school-related activities in comparison to their peers who physically went to school. Transitioning from remote to on-site schooling was associated with more positive feelings toward school and more time spent on school activities. Finally, we observed that greater parental involvement within remotely schooled youth was associated with more positive emotions toward school, while parental involvement did not influence emotions toward school for those who were schooled in-person.

As expected, most of our sample was remotely schooled (fully or partially) during the school year 2020–2021. At the beginning of the school year, most were fully remotely schooled, but from February–March 2021, more youth were schooled in-person, which is in line with the timeline of school reopening in some

states (Week, 2020c). Note that there was an increase in remote schooling (and other unspecified situations) in December, which may be due to (1) school/holiday breaks (i.e., families on a school break may have responded “Other” when asked if their child was being schooled in person or remotely), or (2) the increase in COVID-19 cases between November and February (World Health Organization, 2021), which may have resulted in shifts to remote/other school settings, either by individual families or by entire schools.

We found that students completing school remotely enjoyed school less than those who physically went to school. This is in line with recent findings showing that social, emotional, and academic well-being was reduced for students not attending school in person (Duckworth et al., 2021), and that the impact of remote learning quality on these student’s performance was strongly mediated by their satisfaction with the learning situation (Kerzi et al., 2021). There are multiple factors that might explain the difference between in-person and remotely schooled youth in emotional experience. Several studies have reported significant emotional distress in children who stayed at home during the pandemic (Jiao et al., 2020; Racine et al., 2020). It may be that going to school and seeing other children helped them cope with this emotional distress, as we know



that school experiences, specifically peer-to-peer and student-teacher connections, are critical and defining factors in children's and adolescents' intellectual and social-emotional development (Eccles and Roeser, 2011). While remotely schooled youth may have engaged in web-based interaction with their peers (see Sher, 2009), these structured virtual environments may not have provided the same opportunity for rich social interaction as in-person school contexts. Another factor might be the requirement to sit in front of a computer screen for prolonged hours, which notably increases tiredness and mental health symptoms such as headaches, irritability, and nervousness (Nuutinen et al., 2014). There is also the matter of physical infrastructure; we cannot expect a family's home (where we presume remote instruction was taking place) to be designed as an enjoyable learning center. There is considerable heterogeneity of this factor since every student's home setting is unique, such that not all youth may have had access to a personal computer with internet access in a quiet room. Working in an inadequate environment impacts satisfaction and is likely to yield more negative emotions (e.g., Samdal et al., 1999; Shwu-yong and Waxman, 2009). Whichever factor contributes to this negative perception of schooling, it remains crucial to emphasize that unsatisfactory feelings toward learning are concerning, not the least because enjoying learning is key for future academic success (Linnenbrink-Garcia and Pekrun, 2011; Brubacher and Silinda, 2019; Stephan et al., 2019).

In addition to these emotional effects, we found that remotely-schooled youth spent less time on school-related activities than youth who physically went to school. We observed this pattern in all six subjects we considered in the current study (i.e.,

language arts, social studies, math, science, reading, and "other" learning activities). Assuming the amount of learning time in physical schools is typical of pre-pandemic learning time, we could conclude from these results that remote schooling resulted in a general reduction in learning time. Reduced learning time may provide fewer opportunities for learners to engage with the material, which increases the risk of potential learning loss (Domingue et al., 2021; Halloran et al., 2021). Notably, we found that transitioning from remote to on-site schooling was related to an increase in time spent on all learning abilities. Future studies are still needed to directly assess academic achievement and compare how youth performed this school year as a function of their school setting. That being said, based on previous research, we surmise that any learning loss due to reduced time on school activities is likely to have significant effects on future academic achievement, with youth fully schooled at-home during this school year being the most at risk.

Importantly, although the modal response to questions about parental involvement was "0 h per week" across both groups, we observed that remotely-schooled youth reported being more frequently supervised by their parents. In addition to more pragmatic school-related tasks such as checking homework and assisting with school schedules, parents also reported assisting with pedagogical tasks, such as creating new assignments for their children and, in some cases, directly teaching them. Interestingly, youth who received parental monitoring reported enjoying their school situation more than those who received less support from their parents, suggesting that parents may play an important role in shaping attitudes toward school. These findings are

complementary to recent observations that youth's perceived autonomy during this pandemic learning situation intrinsically differed from the in-person autonomy-supportive arrangements, with fewer opportunities for teachers to intervene when youth have difficulties in handling their learning autonomy (Holzer et al., 2021). Based on these findings, we can assume that parents played a critical supportive role in learning—in the absence of the teacher—during the pandemic. Such an interpretation is consistent with recent calls for better direct supports for parents of youth experiencing remote learning (Mandel, 2020).

While this study advances our understanding of learning environments and attitudes during the COVID-19 pandemic, it also had some limitations. First, the nature of the data set is observational and based on survey reports. We do not have quantitative metrics of academic achievement; however, the lower rating of school enjoyment and the reduced time spent on school activities are likely to negatively impact current and future academic achievement (following Domingue et al., 2021). Second, the data provide clear insights about fully remote and fully in-person school settings but do not allow the assessment of hybrid settings with some days or weeks in person at school and some other days or weeks at home. Future research should focus on such mixed settings that were found in approximately 20% of responding youth. Third, our study includes a longitudinal component that we could not assess on the entire sample, only on the 2,745 youth who responded to the three questionnaires. Further, it is relevant to note that the current sample is less diverse along socio-economic status indicators and reported race than the parent sample from the initial ABCD Study sample (Garavan et al., 2018; Jernigan et al., 2018); specifically most of our respondents were white, the majority of parents had a college degree or higher, and most family yearly income was higher than \$100,000. Our results thus mostly illustrate the schooling situation in youth with average or higher SES. The overall effects of remote schooling we observed in our sample, such as less positive attitude toward school, might thus be even stronger for students from racial/ethnic minorities, those with limited English proficiency, and those who are eligible for free/reduced-price school lunches (Dorn et al., 2020; Parolin and Lee, 2021). Future studies are thus still needed to measure the long-term educational impact of school closure on academic achievement across all children.

To conclude, our findings shed new light on the significant negative impact that pandemic induced shifts toward remote schooling had on student's experiences of school. Specifically, relative to attending school in-person, remote learning was associated with a reduction in positive attitudes toward school, and a reduction in time spent on school-related activities, yet an increase in parental involvement in schooling. In light of well-established findings on how critical peer-to-peer and student-teacher connections are in promoting adolescent intellectual and social-emotional development (Bronfenbrenner and Morris, 2006), the current results suggest remote learning, when paired with low parental involvement, may have unintended impacts on student's experience of schooling, which in

turn will likely impact longer-term academic performance. It will therefore be essential to consider the potential learning risks of remote learning, especially since health benefits of remote learning were found to be limited at best (Mulligan, 2021).

Future school responses to national challenges such as the COVID-19 pandemic may find the specific results of this study useful in seeking to anticipate and even mitigate such negative consequences. Periodic online surveys tied to modest incentives such as the current study may provide actionable insights within particular school settings that move beyond understanding that shifts to remote schooling negatively impact time spent on school subjects and feelings toward schooling, to better understand how such negative impacts could be mitigated, perhaps by providing additional supports to families reporting minimal resources to support students during remote learning. More generally, such dynamic flow of information on how student experiences are changing, and why, may provide new pathways to support students directly, through more effective online supports for meaningful peer-to-peer interactions and teacher-student exchanges, and increased dialogue between schools and parents on how to approach and alleviate the added demands that remote learning places on parents, and the critical role that parents may play in helping children to adapt to the limitations in access to education imposed by the pandemic. Finally, our findings highlight the unique role parents can play in supporting students as they face the challenges of remote education. Future studies should focus on how to best support parents in this educational support role, and help inform policy-making, by investigating how innovative changes in resource allocations may help ensure access to a high quality educational experience for all children.

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. The ABCD data used in this report came from the ABCD 3.0 data release (doi: 10.15154/1519007) and the ABCD COVID-19 Survey Second Data Release (doi: 10.15154/1522601).

ETHICS STATEMENT

Data were collected in 22 sites and each data collection was approved by an Internal Review Board of each institution (see <https://abcdstudy.org/>). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

MGu, ET, AV, LH, QN, CP, AW, and BM: conception of the study. AB-S, AD, GD, MGo, KL, AM, WP, CS, ST, and BM: data collection and critical revisions. MGu: data analysis. MGu, ET, AV, LH, QN, CP, and AW: writing of the first draft. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2022.804191/full#supplementary-material>

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