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Unequal Learning Loss: How the COVID-19 Pandemic Influenced the Academic Growth of Learners at the Tails of the Achievement Distribution

Scott J. Peters
NWEA

Meredith Langi
NWEA

Megan Kuhfeld
NWEA

Karyn Lewis
NWEA

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Unequal Learning Loss: How the COVID-19 Pandemic Influenced the Academic Growth of Learners at the Tails of the Achievement Distribution

Scott J. Peters, Meredith Langi, Megan Kuhfeld, and Karyn Lewis

Houghton Mifflin Harcourt

Scott J. Peters: ORCID: 0000-0003-2459-3384

Meredith Langi: ORCID: 0000-0003-4203-7875

Megan Kuhfeld: ORCID: 0000-0002-2231-5228

Karyn Lewis: ORCID: 0000-0003-4620-2196

All of the authors are employed by Houghton Mifflin Harcourt. NWEA is a division of Houghton Mifflin Harcourt and publishes the MAP-Growth assessment that was used as the primary data source for this study.

Correspondence for this article should be directed to Dr. Scott J. Peters, Houghton Mifflin Harcourt, 121 NW Everett St. Portland, OR 97209. Email: Scott.Peters@hmhco.com

Abstract

The COVID-19 pandemic resulted in substantial unfinished learning for U.S. students, but to differing degrees for various subgroups. For example, students of color, from low-income families, or who attended high-poverty schools experienced greater unfinished learning. In this study we examined the degree of unfinished learning for students who went into the pandemic scoring in the top or bottom 10% in the math or reading achievement distributions. Our results show that students who scored at or below the 10th percentile grew less during the pandemic than their similarly-scoring, pre-COVID peers and, as of the end of the 2021 – 2021 school year, had yet to rebound toward pre-COVID levels of growth or achievement. Conversely, students who scored at or above the 90th percentile largely grew at rates closer to their pre-COVID peers. These students were harmed less academically and have recovered more quickly than their peers scoring at or below the 10th percentile.

Unequal Learning Loss: How the COVID-19 Pandemic Influenced the Academic Growth of Learners at the Tails of the Achievement Distribution

The COVID-19 pandemic had substantial negative effects on the average American student's achievement (Cohodes et al., Betthäuser et al., 2023). Kuhfeld et al. (2022) reported that compared to Fall 2019, Fall 2021 test scores were .20 to .27 standard deviations lower in math and .09 to .18 standard deviations lower in reading. However, these average effects mask a large amount of variation across student groups. While research has indicated Black, Hispanic, and low-income students were disproportionately harmed by school closures and related academic disruptions (Goldhaber et al., 2022), and as a result experienced even greater learning loss due to the pandemic, less is known about the role of students' prior achievement in shaping the magnitude of unfinished learning.

In summer 2022, the Center for Reinventing Public Education produced a review of the literature on COVID-19 unfinished learning (Cohodes et al., 2022). As part of that review, the authors issued a call for further studies on research questions that have yet to be addressed but will be essential to any recovery efforts. The first unanswered question related to how much unfinished learning varied based on students' achievement prior to the pandemic. Reasonable hypotheses could see students who were most advanced prior to the pandemic being harmed most given their lack of access to advanced coursework. Alternatively, perhaps students scoring at the lowest percentiles prior to the pandemic or students with disabilities were harmed most due to lacking access to intensive, specialized supports that were unavailable during virtual learning. In this study, we sought to understand how academic growth for students furthest from average was restricted during the COVID-19 pandemic using data from approximately five million students who took the NWEA Measure of Academic Progress Growth (MAP) assessment between Fall of 2019 and Spring of 2022. Specifically, we sought to answer the following research question:

> Relative to pre-COVID trends, how do achievement gains across the COVID period compare for students who started out at the top or bottom of the achievement distribution?

Examining the scale of unfinished learning for students who were well below or above average when the pandemic began is important for three reasons. First, unequal growth during COVID has the potential to exacerbate the achievement gap between student scoring at the 90th and 10th percentiles. If students going into the pandemic at the 90th percentile continued to grow and learn just as before, but their peers who entered at the 10th percentile fell behind historical growth expectations, then the pandemic would exacerbate already-large 90/10 achievement gaps. This was posed as a likely outcome by Kuhfeld et al. (2020) based on prior research on the effect of summer learning loss and absenteeism. Alternatively, if students at the 10th percentile showed the most growth of any other group during the pandemic, then an outcome could be shrinking achievement disparities. Second, if these two groups showed different rates of academic growth during the pandemic, then students in the post-COVID era will have an even wider range of academic achievement going into future years. As a result, teachers will need to serve and support students with an even-wider range of academic needs than they did in the past (and they were large before COVID – see Pedersen et al., 2023).

And third, there is an implication of this work specific to students with exceptionalities. Differential growth rates for the top and bottom 10% have downstream implications for placement in intensive interventions or in advanced coursework. For example, the developers of the Phonological Awareness Literacy Screening (PALS) assessment recommend flagging students as "at risk" if they score at or below the 20th percentile (National Center on Intensive Intervention, n.d.). Differing rates of growth due to the pandemic could have the effect of increasing the number of students flagged as potentially at-risk since many test-based percentiles were derived before the pandemic (i.e., the 20th percentile and below could include more than 20% of students). Similarly, many gifted and talented programs set qualifying cut scores of the top 5% (e.g., Illinois) or 3% (e.g., Oklahoma). If students initially scoring at the 90th percentile showed slower growth post-pandemic than they did prior to the pandemic, then fewer students will meet percentile-based eligibility criteria for gifted and talented programs. This highlights that it is not only slower growth during the pandemic that is a concern, but also the instructional and resource implications that would come with such changes.

Background

Growth Rates by Prior Achievement

The idea that learning rates or growth differ across student subgroups certainly pre-dates the COVID-19 pandemic. Much attention has been paid to academic growth rates by race / ethnicity or socio-economic status (SES: e.g., Henry et al., 2020; Kuhfeld et al., 2021), often finding that the growth of students of color or those from low-income families falls below that of their peers. For example, Kuhfeld et al. (2021) found that the Black-White math gap was 30% larger in math in eighth grade than it was in kindergarten, due in large part to slower school-year growth rates for Black students. Regarding SES, von Hippel et al., (2019) found that in the ECLS-K: 2011 cohort, the reading gap between the top and bottom quintile of student SES shrank by 25% between the fall of kindergarten and the spring of second grade. In math, it shrank by 17%. Both changes were due to greater growth among bottom- or middle-SES quintile students during the school year. A recent report by Barker and Johnson (2022) found something similar for students with disabilities - faster academic growth than their peers during the school year but losing more ground over the summer. As a result, while students with disabilities started kindergarten roughly half a standard deviation behind their peers without disabilities, by the end of 4th grade, they were one standard deviation behind their peers. Due (mostly) to summer loss, students with disabilities were able to grow faster during the year and yet still end up further behind at the end of 4th grade.

Other research has examined the effect that prior content mastery has on subsequent content mastery. In a meta-analysis on the topic, Simonsmeier et al. (2021) found that while pretest knowledge is strongly correlated with posttest knowledge (r=.53), it was not significantly correlated with growth. Both findings were also independent of student age. However, it’s worth noting that the prediction interval for the effect of prior knowledge on growth ranged from -.688 to .621, suggesting that in some studies, prior knowledge was a strong predictor of growth. The authors suggested this might be due to a knowledge threshold hypothesis whereby growth is high for students with lower levels of prior knowledge as they are still learning essential basic skills, but growth is low for students with higher levels of prior knowledge because they've already mastered those basic skills. This would seem to support related research by Rambo-Hernandez and McCoach (2015) who found that initially high-achieving students in reading grew far less during the school year than their typically-achieving peers. In fact, high-achieving students exhibited almost no change in their rate of growth between school year and summer, whereas typically-achieving students showed substantial growth during school, but little to none over the summer. In sum, the research literature seems to offer support for either hypothesis – that academic growth would be expected to vary by initial achievement prior to the pandemic, or that it would be irrelevant. Clarifying this relationship, particularly for the students furthest from average, particularly post-COVID, is the goal of the present study.

Differential COVID-19 Unfinished Learning by Student Group

As the pandemic has progressed, an increasing number of studies and reports have provided a greater understanding of the unfinished learning that resulted and how it differed by school and student characteristics. Betthäuser et al. (2023) conducted a preregistered systematic review and meta-analysis of 42 studies across 15 countries on COVID unfinished learning. Roughly half of the estimates were from the United States. Across all studies, the overall effect size was d=-0.14 (-.017, -.010) or roughly the equivalent of students losing one-third of a typical school year. On average, unfinished learning was 1) worse in math than in reading (though these differences were small), 2) worse in middle-income countries than high-income countries, and 3) worse for students from low-SES backgrounds.

Turning to a few illustrative, individual studies, a 2021 report by Renaissance Learning (publishers of the STAR assessment) showed overall slower growth for the 2020 – 2021 school year when compared to 2018 – 2019. On average, this slower growth resulted in four percentile-rank points (PR) of unfinished learning in reading and 11 points in math. To arrive at this outcome, the authors converted percentile ranks (PR) to normal curve equivalents, calculated pre- and post-pandemic average scores, and then converted these back to percentile ranks. As unfortunate as the results were, the top-line averages hide even more unfinished learning for specific subgroups. For example, in reading, while White students were only 2 PR points below pre-COVID expectations, the scope of unfinished learning for Black and Hispanic students was 11 and 7 PR points, respectively. In math for the Spring of 2021, White students were 7 PR points below pre-COVID expectations, while Black and Hispanic students were 19 and 16 PR points lower, on average, respectively. Growth for students with disabilities also slowed when compared to similar students in the 2018 – 2019 school year. By spring 2021, they were 5 PR points behind their pre-pandemic peers in reading and 10 in math, though this finding was based on a smaller, less-representative sample.

Part of these unequal rates of COVID unfinished learning stem from students from traditionally marginalized groups, on average, also being in virtual instruction longer than their peers (Cohodes et al., 2022; Oster et al., 2021). Given the well-established effects of school closures on student learning (Goldhaber et al., 2022; Hammerstein et al., 2021) it is not surprising that student groups who were in virtual learning environments for longer would see more unfinished learning. But it wasn’t purely the higher incidence of virtual learning that explains these differences. Goldhaber et al. (2022) showed that roughly one-third of the differences in pandemic-era achievement gains between high- and low-poverty schools was due to differences in how often students were in virtual instruction. One-half of the difference was due to high-poverty schools experiencing greater negative effects than their lower-poverty peers, even when they were in virtual instruction for the same amount of time. This means it wasn’t just that some students were in virtual instruction longer (e.g., low-SES students), but that the effect of virtual learning also had a greater negative effect on their learning.

Much of what is known about the effects of COVID-19 school closures serves as an excellent example of the limitations of averages or marginal effects – they mask large differences in effects for various groups of students or who started out achieving at different levels. The research cited above seems to establish that students of color and those from low-income families fell further behind their pre-COVID peers than did their White or Asian peers. What is not known is how pandemic-era growth differed from pre-pandemic growth for students who started out scoring at very high or very low levels.

Unfinished Learning by Pre-COVID Academic Achievement

A smaller number of studies have examined whether COVID-era growth rates varied by pre-COVID achievement. Kogan and Lavertu (2022) quantified the amount of unfinished learning in Ohio between Fall 2019 and Spring 2021 conditional on Fall 2019 achievement quartiles. Students who scored in the bottom English / language arts (ELA) quartile grew less during COVID (growth of about d=~.61) compared to their pre-COVID growth (d=~.79). For students in the top quartile, the pre- and post-COVID growth in ELA was almost identical (approximately d=.3). This represents a kind of Matthew Effect where students who started out achieving at high levels maintained a consistent level of growth through the early part of the pandemic while their peers who were achieving at lower levels slowed substantially. If students who are scoring at lower levels prior to the pandemic experienced the greatest learning loss, the result would be increased achievement dispersion going into the 2022 – 2023 school year.

Dawson (2022) conducted a similar study to Renaissance Learning (2021) using the i-ready assessment platform. Particularly interesting about this analysis was that it examined growth as a factor of students' relation to grade-level instructional standards, prior to COVID, as opposed to by starting achievement percentile. Although all students have unfinished learning because of the pandemic, in reading, students who were two or more grade levels behind their chronological grade when they tested in the Fall of second grade (prior to COVID) showed the greatest difference between expected and observed achievement in the Fall of 4^{th} grade. Students who scored one year below grade level in reading or those who scored at grade level showed COVID-era growth that was more-similar to pre-COVID trends. It was only the group of students who started out furthest below grade-level standards that showed slower growth rates during the pandemic. In math, the scale of learning loss was more consistent. All students, regardless of initial achievement, showed slower academic growth during COVID.

Schult et al. (2022) conducted a similar study to our present analysis in that the authors evaluated the degree of unfinished learning disaggregated by initial proficiency in Fall of 2020 following school closures from March until May 2020. These included students initially scoring at the 5th, 25th, 50th, 75th, and 95th percentiles in reading comprehension, mathematical operations, and numbers. Mathematical operations included the application and combination of arithmetic processes while the numbers test assessed understanding, interpretation, and application of different numerical representations (e.g., numeric vs. figural). Importantly, this study was conducted using data from one German state of approximately 80,000 students and followed a relatively short period of school closure compared to those in the United States. In operations and numbers, students at the 5th and 25th percentiles of initial achievement showed the greatest negative difference in score between the COVID and pre-COVID samples. This was especially pronounced in operations where the 5th percentile group scored 28 points lower and the 95th percentile group scored 11 points higher than their pre-COVID peers, thereby substantially widening the overall dispersion of scores. Given the German context and the relatively short period of school closure, these findings have less relevance to the present study. Still, the observed Matthew Effect in mathematics with higher achieving students maintaining their pre-COVID growth trends and the lowest-achieving students scoring even lower than did their pre-COVID peers would result in greater dispersion of student achievement than was already present prior to the pandemic.

Finally, Lewis and Kuhfeld (2021) conducted the most relevant study to the present paper as it also made use of NWEA MAP data and tracked students from Fall 2019 to Fall of 2021, including by initial achievement quintile. In reading, students in the top 20% of achievement met or exceeded their growth expectations while students in the bottom 20% showed slower growth compared to pre-COVID norms (32nd to 39th conditional growth percentiles depending on the grade and based on pre-COVID norms). These conditional growth percentiles compare an individual student's COVID-era growth to projected growth based on a pre-pandemic sample of students who had the same starting achievement, where a CGP of 50 indicates that student's projected and actual growth were the same. As a trend, the lower a student's Fall 2019 achievement, the further from typical growth they were during the pandemic. The same trend was apparent in math with the only difference being that even the top quintile of math achievers in Fall 2019 still grew less than expected (40^{th}-45^{th} CGP). Bottom quintile showed even slower growth (26^{th} – 32^{nd} GCP). While informative, this analysis did not apply the same seasonality approach (i.e. separating out summer vs. school year growth) as some prior studies (e.g., von Hippel, 2018) and only covered the period up through Fall 2021. The present study seeks to extend that analysis while also focusing on COVID-era unfinished learning for the most-exceptional learners.

Methods

Measure

The data for this study come from the longitudinal growth database at NWEA. Specifically, we used student test scores from NWEA's MAP Growth assessment across multiple years and grades. MAP Growth is a computer adaptive assessment that assesses students from K-12 in reading and math. It is particularly useful for exploring our research question because the assessment is vertically scaled in Rasch units (i.e. RIT scores) and is typically administered at least two times per year (Fall and Spring) (NWEA, 2019). Additionally, the adaptive nature and multi-grade item pool of MAP Growth makes it ideal for studying differences in growth based on prior performance because it adapts to assess students even in the highest and lowest percentiles. Conditional standard errors for MAP Growth are very similar across nearly the entire range of possible scores. It also applies a sophisticated norming procedure to estimate nationally representative achievement and growth norms, the most recent of which were released in 2020 and are based on pre-pandemic student performance (Thum & Kuhfeld, 2020). The present study used those norms to identify students who scored in the top or bottom 10% of the distribution, what we refer to going forward as the top or bottom decile of the math or reading achievement distribution.

The COVID pandemic caused disruptions in the typical assessment cycle and most students did not test in Spring of 2020 (what we refer to as the Spring of Year 1). Additionally, students in the 2020-2021 school year tested across a combination of remote and in-person modalities and on a wider range of testing schedules, which differs from past practices. To address potential concerns from this issue, Kuhfeld et al (2020) compared the psychometric properties of MAP Growth assessments from the Fall of 2020, collected in a subset of districts that administered both remote and in-person assessments. Their findings suggest that results are reasonably comparable for students in grades 3-8 but may not be so for grades K-2. Given this finding, and following Kuhfeld et al. (2022), we focused on grades 3-8 for this analysis.

Analytic Sample

We leveraged MAP Growth test scores from approximately five million students across two longitudinal samples in both reading and in math. The first is referred to as the COVID sample, as they are the students of primary interest who were impacted by the pandemic. For this sample, we identify students in grades 3-8 with observed math and/or reading scores in Fall of 2019 and followed their growth trajectories for three years (2019 – 2020, 2020-21, and 2021 – 2022 which for brevity we refer to as Year 1, Year 2, and Year 3 respectively). The second is a comparison sample of students who completed MAP Growth in the three years immediately preceding the pandemic (2016 - 2017 to 2018 - 2019), referred to as the pre-COVID sample. For these students, we identify students who had math and/or reading scores in Fall of 2016 as the starting year.

We further split our analytic samples based on their achievement percentile in the first Fall (2019 or 2016) based on NWEA MAP Growth 2020 norms (Thum & Kuhfeld, 2020), which represent national performance on the MAP Growth assessments prior to the COVID-19 pandemic. Specifically, we used the 2020 norms to establish the RIT scores associated with the 10^{th} and 90^{th} percentiles in each grade subject from the national sample, and then used those scores as cut-offs to identify students who scored at or below the 10^{th} percentile or at or above the 90^{th} percentile in the Fall of 2016 (pre-COVID sample) or

Fall 2019 (COVID sample). For the sake of parsimony, we refer to these two achievement groups as students scoring in the top or bottom achievement decile in the Fall of Year 1. This sampling approach resulted in eight analytic samples: math and reading for bottom decile students, and math and reading for top decile students, all for COVID and pre-COVID students. Details for the COVID samples in the Fall of 2019 for math and reading are presented in Tables 1 and 2. Details for the pre-COVID samples in the Fall of 2016 are presented in Tables 3 and 4.

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Tables 1 through 4 Here

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One important note regarding the COVID analytic sample is that due to the impact of the pandemic, very few students tested in Spring 2020 and are not representative of the pre-COVID sample. While we still include this term in our model and results (discussed below), we emphasize that the results from this term should be interpreted with caution and focus most of our attention on the Year 2 and Year 3 school years.

Analytic Approach

To estimate growth for students starting in the top or bottom achievement deciles, we applied multilevel growth models separately to each of our eight analytic samples. This allowed us to focus our comparisons on the differences in growth between the COVID and pre-COVID samples. To specify these multilevel growth models, we consider students' longitudinal test scores to be nested within students and schools. Following the same methods as Kuhfeld and Lewis (2022), we consider growth rates to be linear functions of the number of months a student has been in school for each academic year, as well as a function of the number of months a student is on summer break. To calculate the number of months a student has been in school prior to testing, we count the number of days since the start of the academic school year for each students' school up to the test event date and divide by thirty. The number of summer months is based on the number of days from the end of the previous academic year to the start of the following academic year. Importantly, for the first year in the COVID sample, the summer months are counted to include the Spring 2020 school closures. This was done intentionally based on the hypothesis that school closures had an impact on instruction like that of summer break.

The multilevel growth model is given below. A test score, y_{tij}, for student i at time t in school j, is modeled as a function of the number of months in academic years 1, 2 and 3 ($MonY1_{tij}$, $MonY2_{tij}$, $MonY3_{tij}$), the number of months in first summer and school closures ($MonS1_{tij}$), and the number of months in the second summer ($MonS2_{tij}$):

$$y_{tij} = \beta_0 + \beta_1 MonY1_{tij} + \beta_2 MonS1_{tij} + \beta_3 MonY2_{tij} + \beta_4 MonS2_{tij} + \beta_5 MonY3_{tij} +$$

$$u_{0j} + r_{0ij} + \epsilon_{tij}.$$

In this model, β_0 is the intercept, interpreted as the predicted average score on the first day of school in the first academic year, β_1 is the average RIT score gain per month in the first academic school year. In the pre-COVID sample, this represents the average monthly growth rate across the entire 2016-2017 academic school year. In the COVID sample, it represents the average monthly growth rate across the 2019-2020 school year until the school closures in March. β_2 is the average RIT score gain, or loss when negative, per month of the summer break, (and school closures for the COVID sample). β_3 is the average RIT gain per month in the second academic year, β_4 is the average RIT gain/loss per month in the second summer, and β_5 is the average RIT gain per month in the third academic year. Finally, we include a level-one residual term (ϵ_{tij}) as well as a student-level (r_{0ij}) and school-level (u_{0j}) random intercept terms.

Models were estimated separately by grade and subject, for both the COVID and pre-COVID samples. We then compared main effects estimates between COVID and pre-COVID samples were lme4 in R (Bates et al., 2015).

Results

Tables 5 and 6 include the specific growth model parameter estimates for the four grade cohorts (i.e., grades 3-5, 4-6, 5-7, and 6-8). Figure 1 displays model-implied growth trajectories for the COVID and the pre-COVID samples separately by starting decile (bottom decile in the top row and top decile in the bottom row) and subject (reading on the left and math on the right). The figure shows results for the grade 3-5 cohort, but as we outline in the following section, the results are largely the same across grade-levels. Growth curve plots for the other cohorts are included in the online appendix.

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Tables 5 and 6 Here

Figure 1 Here

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Students Who Went into the Pandemic Scoring in the Bottom Decile Experienced Greater Unfinished Learning

Overall, Figure 1 shows that students who started in the bottom decile had their growth restricted more during COVID than did their top-decile peers during Year 2. What's more, during Year 3 students in the bottom decile showed less evidence of rebounding back to pre-COVID levels. The end result of these different patterns of growth across Year 2 and Year 3 is that bottom decile students incurred more harm from the pandemic during Year 2 and made less progress towards recovery in Year 3 compared to top decile students. Figure 2 presents the ratio of COVID sample growth relative to pre-COVID growth. Any value <100% indicates students grew less during COVID compared to pre-COVID peers and any value >100% indicates students grew more during COVID than pre-COVID peers.

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Figure 2 Here

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Growth for Students in the Bottom Decile

Looking at the top row of Figure 1 makes clear that students who started in the bottom decile grew less in reading and math in Year 2 than did their pre-COVID peers. In fact, as shown in Figure 2, these students grew less than two-thirds as much as their pre-COVID peers (62% in math and 61% in reading) and this decreased growth was evident across all cohorts in both subjects. Year 3 growth was closer to pre-COVID trends (92% in reading and in math), but still fell short of pre-COVID levels which means the gap was still widening. Across cohorts, Year 3 growth for bottom decile students in the COVID sample was between 88% and 100% as much as their pre-COVID peers in math and between 77% and 92% in reading. In other words, except for one cohort in math, gaps for bottom decile students continued to accumulate in reading and math during Year 3.

Growth for Students in the Top Decile

The bottom row of Figure 1 presents the model-implied growth trajectories for students who scored in the top decile in the Fall of Year 1. In contrast to the growth trends for bottom decile students that lagged pre-pandemic trends, what stands out about top decile students is how similar growth trends were during Year 2 for the COVID and pre-COVID samples – the lines appear near-parallel. Figure 2 reinforces this point - top decile math students during COVID grew between 89% and 104% as much as their pre-COVID peers in Year 2. In reading, top decile students in the COVID sample grew 57% to 85% as much as their pre-COVID peers (although fall to spring reading growth rates for top decile students are generally flatter and thus the difference in test scores is actually very small). Going into Year 3, nearly all top decile grade cohorts grew *more* from Fall to Spring (104% to 109% in math and 92% to 119% in reading) than their pre-COVID peers, thus shrinking the distance between pre-COVID levels of achievement in most cases. As a result, top decile students' scores were at or nearing parity with pre-COVID trends by the end of Year 3.

Summary

In sum, students who were scoring at the lowest levels prior to COVID also experienced the greatest negative effects to their learning during COVID. Not only did their growth lag behind that of their pre-COVID peers during Year 2 when many schools were closed or in virtual learning, but these students were still lagging their pre-COVID peers into Year 3 (the 2021 – 2022 school year) when high scoring peers were growing at rates that actually *exceeded* pre-pandemic trends. As a result, students in the top deciles have made significant progress towards academic recovery while students that started in the bottom deciles have yet to turn the corner and are much further from attaining pre-COVID levels of growth or achievement. These differential patterns mean that, as of the end of Year 3, the distance between the two groups has only widened.

Discussion

Our findings of greater unfinished learning for bottom decile students compared to top decile students seem to align with those presented by the 2022 Main NAEP. Although NAEP does not track students longitudinally, the drop in 10th percentile average score from 2019 to 2022 (Years 1 and 3 in our study) corroborate our findings showing students scoring in the bottom decile had their learning restricted most during the pandemic. Similarly, students in our study who scored in the top decile in Year 1 (Fall 2019) were harmed the least, largely maintaining similar rates of learning as their pre-COVID peers. The present findings are further evidence of a Matthew Effect, whereby students who were already performing at the highest levels before the pandemic maintained their advantage or became relatively even-more advantaged due to the drop in growth and achievement for students in the bottom decile. Conceptually, this can be thought of as a downward stretching of the overall achievement distribution with the 90th percentile largely staying in place.

What Effect did the Pandemic Have on Achievement Disparities?

Although it was not a primary focus of the present study, the findings described above have implications for the size of the achievement gap between students at the 90th and 10th percentiles. When two groups grow at different rates, as we observed in the present study, the gap between the two groups will grow. In reading, the size of the gap between 90th and 10th percentile students was 4% to 8% larger, depending on grade level, in 2022 than it was in 2019. For math, the gap was roughly 10% larger in the early grades and unchanged in the middle grades (see Kuhfeld & Lewis, 2022; Lewis et al., 2022). As a result of the unequal levels of growth during the pandemic, the highest- and lowest-scoring students have grown further apart in math and reading.

Implications for Students with Exceptionalities

The overall downward shift in the achievement distribution, particularly at lower levels of achievement, has some downstream implications that carry special relevance for exceptional learners. Specifically, the results of this study bring up two possibilities: 1) that the gap in achievement between students who do and do not have disabilities may have grown and 2) that when compared to before the pandemic, larger numbers of students might be flagged as "at risk" or classified as having a disability. We discuss each of these in turn while emphasizing these are only possible implications from our findings as we did not have student-level data on who was or was not classified as having a disability.

First, the widening gap between students scoring in the top and bottom deciles highlights the possibility of widening gaps between students who do and do not have disabilities. Although we did not have data on which of the students in our dataset did or did not have disabilities, students with disabilities are disproportionately overrepresented among those scoring at lower achievement percentiles. For example, the 2022 NAEP data for 4th grade shows that 53% of students with disabilities were classified as scoring "below basic" in math compared to 20% of students who do not have disabilities. Assuming a similar distribution of scores on MAP Growth would mean a disproportionately large percentage of students scoring at the 10th percentile are students with disabilities. If students in the bottom decile fell further behind because of COVID and students with disabilities make up a disproportional percentage of students in the bottom decile, then it's likely that the gap in achievement between students who do and do not have disabilities has gotten wider.

Second, our findings also bring forth the possibility that larger numbers of students will be flagged as potentially having a disability. As noted in the introduction, many policies and interventions flag students who score at or below a given percentile as potentially in need of intensive intervention or in need of additional diagnostic assessment to determine if the student has a disability. But most of the percentiles used to make these decisions are based on pre-COVID samples. Given the nature and scale of learning loss described above, more students could fall at or below the 10th percentile than did in the pre-COVID years. This might seem counterintuitive – how can more than 10% of students score at or below the 10th percentile? But again, the 10th percentile cut score, and similar cut scores used to flag students for additional interventions on other assessments, are based on pre-COVID data. Pre-COVID percentile cut scores plus students scoring at the lowest levels experiencing the greatest amount of learning loss is a recipe for larger numbers of students meeting those pre-COVID percentile criteria. Future research needs to examine if this has indeed come to pass.

Interestingly, our results do not suggest a shift in size for the top decile. Returning to Figure 1, by the end of Year 3, the lines for both the COVID and pre-COVID students largely overlap, particularly in reading. The mean score for the top 10% of students is largely the same in the COVID era as it was in the pre-COVID era. This suggests the size of the top 10% where the cut score for the top 10% is based on pre-COVID norms (a proxy for “gifted and talented”), is likely to be similar going forward post-Covid. So while more students are likely to score at or below the 10th percentile as a result of COVID, roughly the same proportion of students will score at the 90th percentile.

Limitations

These data come from a large national sample of students who completed the NWEA MAP Growth test, but that does not mean the results are necessarily representative of the nation as a whole or any single state. Instead, they were especially useful for this question because of MAP Growth’s vertical, grade-independent scale and computer adaptive design. Similarly, although there are implications for exceptional learners, we did not have data on which individual students were labeled as having a disability or as gifted and talented. Future research on students who are confirmed as having been diagnosed as having a disability is needed. And finally, while we selected our COVID and pre-COVID samples based on their Year 1 scores, the two samples differed in other ways. For example, Table 1 reports that Black students made up approximately 15% of the COVID sample, but 17% to 18% of the pre-COVID sample. The total sample sizes were also different because different numbers of students were tested with MAP Growth pre- and post-COVID.

Conclusion

Much of American educational policy is focused on student growth and narrowing the achievement disparities between groups. Substantial research has already established that 1) growth slowed for all students during COVID and 2) COVID exacerbated pre-existing disparities across subgroups. The present study extended that knowledge to show that students scoring in the top decile prior to the pandemic were largely insulated from COVID-related learning loss while their peer scoring in the bottom decile had their learning restricted substantially. Going forward, pandemic recovery efforts should focus on the lowest-scoring students with an eye toward, at the very least, returning them to their pre-pandemic baseline. For example, although high-dose tutoring has received substantial attention as a possible way to mitigate COVID unfinished learning (Robinson et al., 2021), implementation has proven challenging with many of the neediest students being least likely to participate. A December 2022 survey found that only 24% of parents whose children typically earned grades of C or lower received any tutoring in Fall 2022 and an even smaller number (11% total) were receiving high-quality tutoring (Rapaport & Silver, 2023). Others have argued these approaches are never going to return students to pre-COVID levels and that the most-effective teachers need to be reassigned to the student furthest behind (Raymond, 2023). Where these arguments agree is that it will take substantial effort to help America's most-struggling learners recover from COVID unfinished learning.

But while schools should focus their recovery efforts on those students furthest behind, they should also reflect on why the pandemic had so little influence on the growth of more-advanced learners and the degree to which grade-level instruction is or is not resulting in growth for high achievers. It is certainly a positive that these students seemed to maintain typical levels of growth during the pandemic, but it is also potentially concerning that these students seemed to grow at similar levels even when they were in virtual instruction or even when schools were closed completely. In other words, why is it that school seemed to matter less for high achievers? The same researchers who suggested the most-effective teachers be assigned to the students who need the most help (Raymond, 2023) also argued for allowing advanced learners to proceed more quickly and move on to advanced content, even to the point of finishing school sooner. This would allow them to grow faster than they currently are and allow for their unused resources to be reallocated to learners who need additional support.

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Figure 1

Model-implied COVID and Pre-COVID Growth Trajectories for Students in the Grades 3-5 Cohort

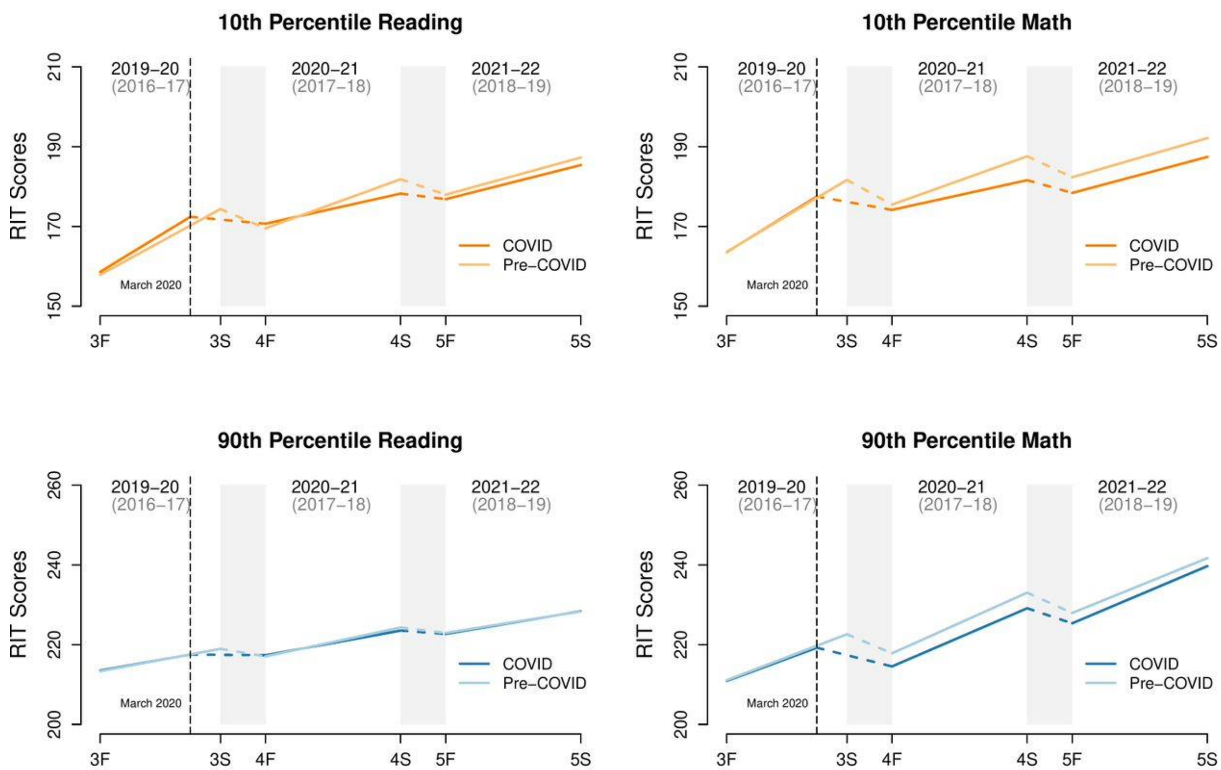

Figure 2

Ratios Between COVID and Pre-COVID Growth Rates and School Year

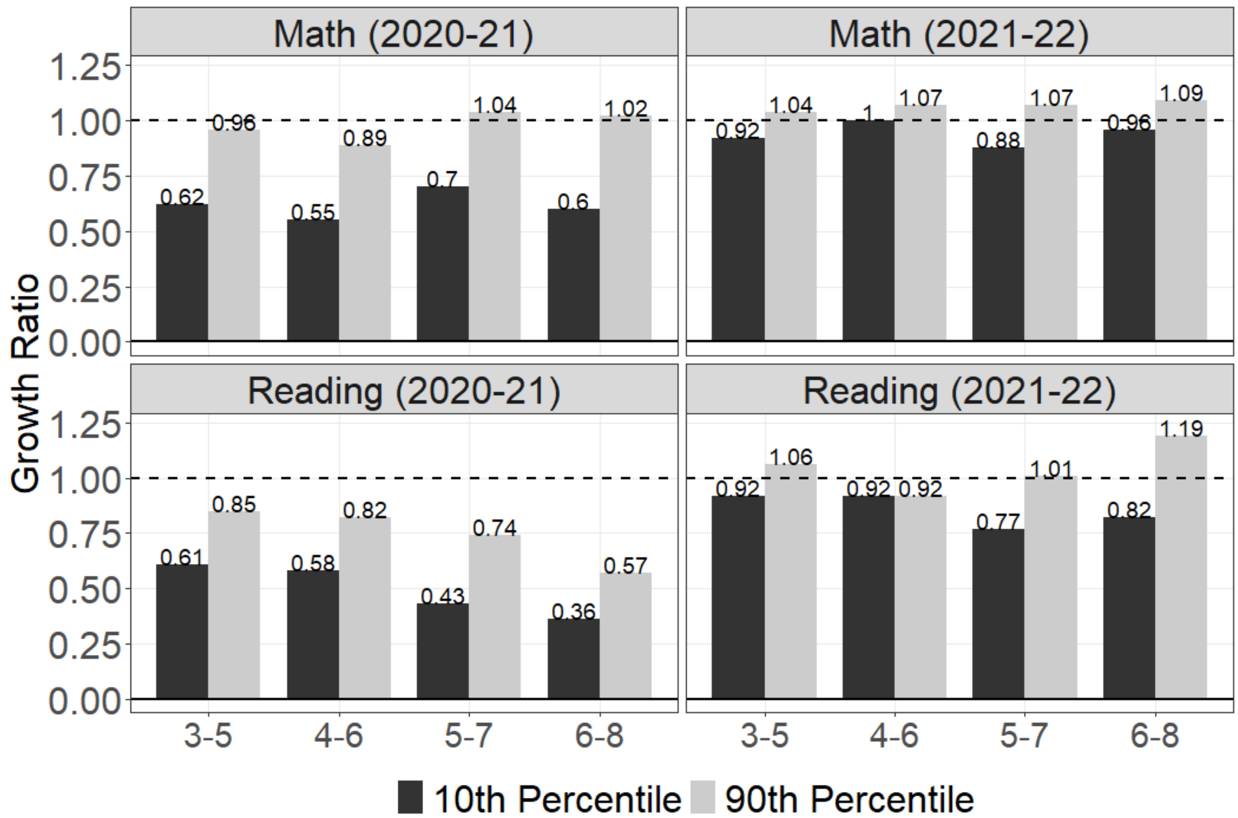

Table 1

Sample Descriptive Statistics for Math: COVID Sample

Grade (2019-2020 to 2021-2022)	N	American Indian/ Alaskan Native	Asian	Black	Hispanic	Multi-Racial	Native Hawaiian/ Pacific Islander	White
Full Sample								
3-5	634998	0.011	0.043	0.153	0.201	0.047	0.002	0.489
4-6	692711	0.011	0.044	0.152	0.208	0.046	0.002	0.482
5-7	708845	0.011	0.043	0.152	0.212	0.046	0.002	0.480
6-8	725828	0.012	0.043	0.151	0.214	0.044	0.002	0.482
Percentile Rank <=10th								
3-5	39721	0.017	0.029	0.251	0.300	0.038	0.003	0.315
4-6	51538	0.016	0.020	0.247	0.287	0.038	0.003	0.341
5-7	51000	0.021	0.018	0.264	0.292	0.037	0.002	0.319
6-8	45423	0.024	0.018	0.278	0.299	0.036	0.002	0.301
Percentile Rank >=90th								
3-5	44987	0.008	0.088	0.057	0.076	0.044	0.001	0.663
4-6	66166	0.008	0.103	0.054	0.089	0.042	0.001	0.644
5-7	59420	0.007	0.114	0.050	0.087	0.042	0.001	0.637
6-8	54406	0.007	0.129	0.042	0.089	0.040	0.001	0.635

Table 2

Sample Descriptive Statistics for Reading: COVID Sample

Grade (2019-2020 to 2021-2022)	N	American Indian/ Alaskan Native	Asian	Black	Hispanic	Multi-Racial	Native Hawaiian/ Pacific Islander	White
Full Sample								
3-5	621537	0.012	0.042	0.156	0.198	0.049	0.002	0.493
4-6	693976	0.011	0.044	0.154	0.202	0.046	0.002	0.485
5-7	701554	0.012	0.042	0.153	0.207	0.046	0.002	0.484
6-8	714631	0.012	0.042	0.151	0.209	0.045	0.002	0.485
Percentile Rank <=10th								
3-5	32602	0.018	0.033	0.240	0.294	0.037	0.003	0.327
4-6	51675	0.018	0.023	0.221	0.282	0.039	0.003	0.362
5-7	57640	0.021	0.020	0.231	0.283	0.038	0.002	0.352
6-8	51718	0.023	0.020	0.240	0.294	0.037	0.002	0.334
Percentile Rank >=90th								
3-5	50437	0.008	0.073	0.081	0.048	0.048	0.002	0.645
4-6	75613	0.008	0.084	0.080	0.047	0.047	0.002	0.628
5-7	64831	0.007	0.086	0.069	0.044	0.044	0.002	0.644
6-8	56368	0.007	0.091	0.060	0.043	0.043	0.001	0.648

Table 3

Sample Descriptive Statistics for Math: Pre-COVID Sample

Grade (2016-2017 to 2018-2019)	N	American Indian/ Alaskan Native	Asian	Black	Hispanic	Multi-Racial	Native Hawaiian/ Pacific Islander	White
Full Sample								
3-5	776253	0.017	0.043	0.179	0.196	0.043	0.002	0.509
4-6	821138	0.017	0.040	0.166	0.178	0.038	0.002	0.488
5-7	815457	0.018	0.041	0.168	0.186	0.039	0.002	0.505
6-8	836219	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Percentile Rank <=10th								
3-5	49402	0.026	0.032	0.282	0.258	0.034	0.002	0.307
4-6	54443	0.025	0.023	0.271	0.245	0.036	0.002	0.335
5-7	56806	0.031	0.020	0.274	0.254	0.035	0.002	0.322
6-8	50883	0.035	0.020	0.299	0.250	0.033	0.002	0.299
Percentile Rank >=90th								
3-5	49932	0.006	0.083	0.066	0.067	0.038	0.001	0.679
4-6	74115	0.008	0.092	0.059	0.071	0.039	0.001	0.666
5-7	66382	0.007	0.108	0.047	0.068	0.037	0.001	0.664
6-8	67178	0.007	0.111	0.041	0.070	0.038	0.001	0.667

Table 4

Sample Descriptive Statistics for Reading: Pre-COVID Sample

Grade (2016-2017 to 2018-2019)	N	American Indian/ Alaskan Native	Asian	Black	Hispanic	Multi-Racial	Native Hawaiian/ Pacific Islander	White
Full Sample								
3-5	759925	0.016	0.040	0.183	0.176	0.041	0.002	0.481
4-6	821935	0.017	0.040	0.173	0.182	0.040	0.002	0.483
5-7	813704	0.017	0.039	0.172	0.176	0.037	0.002	0.493
6-8	831281	0.018	0.039	0.168	0.177	0.037	0.002	0.495
Percentile Rank <=10th								
3-5	41408	0.025	0.036	0.279	0.256	0.034	0.002	0.307
4-6	64564	0.025	0.026	0.245	0.255	0.033	0.001	0.351
5-7	71290	0.030	0.021	0.242	0.260	0.033	0.002	0.352
6-8	63780	0.035	0.023	0.261	0.253	0.031	0.002	0.336
Percentile Rank >=90th								
3-5	55892	0.006	0.069	0.098	0.041	0.041	0.001	0.655
4-6	90595	0.008	0.072	0.087	0.039	0.039	0.001	0.649
5-7	76268	0.007	0.076	0.070	0.039	0.039	0.001	0.667
6-8	61482	0.007	0.082	0.060	0.038	0.038	0.001	0.676

Table 5

Estimated Fixed Effects for Hierarchical Linear Growth Models in Math for Students in the 10th Percentile and Below

Grade-span	Sample	Intercept	*Year 1 Linear Growth**	*Summer Year 1 Growth**	Year 2 Linear Growth	Summer Year 2 Growth	Year 3 Linear Growth
3 to 5	COVID	161.23	*2.32*	*-0.67*	0.83	-1.07	1
		(0.06)	*(0.03)*	*(0.04)*	(0.01)	(0.03)	(0.01)
	Pre-COVID	161.39	2.25	-2.06	1.35	-1.75	1.09
		(0.06)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
4 to 6	COVID	170.53	*1.74*	*-0.52*	0.6	-0.7	0.82
		(0.06)	*(0.03)*	*(0.04)*	(0.01)	(0.03)	(0.01)
	Pre-COVID	170.57	1.81	-1.77	1.08	-1.92	0.82
		(0.06)	(0.01)	(0.02)	(0.01)	(0.03)	(0.01)
5 to 7	COVID	179.37	*1.43*	*-0.62*	0.56	-0.71	0.58
		(0.06)	*(0.02)*	*(0.04)*	(0.01)	(0.03)	(0.01)
	Pre-COVID	179.08	1.51	-2.18	0.8	-0.78	0.66
		(0.06)	(0.01)	(0.02)	(0.01)	(0.03)	(0.01)
6 to 8	COVID	184.31	*1.25*	*-0.51*	0.42	-0.46	0.55
		(0.06)	*(0.02)*	*(0.04)*	(0.01)	(0.03)	(0.01)
	Pre-COVID	183.28	1.25	-1.11	0.7	-0.48	0.57
		(0.06)	(0.01)	(0.02)	(0.01)	(0.03)	(0.01)

Note: * Estimated coefficients for the COVID sample are impacted by the limited sample in the spring of 2020 and should therefore be interpreted with caution. The columns with gains ratios display the rate of growth for the COVID sample divided by the rate of growth for the pre-COVID sample in that time period.

Table 6

Estimated Fixed Effects for Hierarchical Linear Growth Models in Reading for Students in the 10th Percentile and Below

Grade-span	Sample	Intercept	*Year 1 Linear Growth**	*Summer Year 1 Growth**	Year 2 Linear Growth	Summer Year 2 Growth	Year 3 Linear Growth
3 to 5	COVID	156.30	*2.30*	*-0.35*	0.84	-0.47	0.95
		(0.07)	*(0.03)*	*(0.05)*	(0.01)	(0.03)	(0.01)
	Pre-COVID	155.80	2.06	-1.61	1.37	-1.29	1.03
		(0.05)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
4 to 6	COVID	164.00	*1.95*	*-0.23*	0.67	-0.20	0.73
		(0.07)	*(0.03)*	*(0.05)*	(0.01)	(0.03)	(0.01)
	Pre-COVID	163.41	1.88	-1.38	1.16	-1.18	0.80
		(0.06)	(0.01)	(0.02)	(0.01)	(0.03)	(0.01)
5 to 7	COVID	171.12	*1.83*	*-0.15*	0.39	-0.09	0.50
		(0.07)	*(0.03)*	*(0.05)*	(0.01)	(0.03)	(0.01)
	Pre-COVID	170.81	1.72	-1.45	0.92	-0.80	0.64
		(0.06)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)
6 to 8	COVID	176.89	*1.59*	*-0.20*	0.26	0.26	0.43
		(0.07)	*(0.03)*	*(0.04)*	(0.01)	(0.03)	(0.01)
	Pre-COVID	175.70	1.54	-0.88	0.74	-0.32	0.52
		(0.07)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)

Note: * Estimated coefficients for the COVID sample are impacted by the limited sample in the spring of 2020 and should therefore be interpreted with caution. The columns with gains ratios display the rate of growth for the COVID sample divided by the rate of growth for the pre-COVID sample in that time period.

Table 7

Estimated Fixed Effects for Hierarchical Linear Growth Models in Math for Students in the 90th Percentile and Above

Grade-span	Sample	Intercept	*Year 1 Linear Growth**	*Summer Year 1 Growth**	Year 2 Linear Growth	Summer Year 2 Growth	Year 3 Linear Growth
3 to 5	COVID	209.52	*1.39*	*-0.94*	1.62	-1.25	1.59
		(0.04)	*(0.02)*	*(0.02)*	(0.00)	(0.02)	(0.00)
	Pre-COVID	209.65	1.44	-1.60	1.69	-1.70	1.53
		(0.04)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
4 to 6	COVID	222.77	*1.41*	*-0.88*	1.42	-3.44	1.30
		(0.04)	*(0.02)*	*(0.02)*	(0.00)	(0.02)	(0.00)
	Pre-COVID	222.77	1.41	-1.78	1.60	-4.11	1.21
		(0.04)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
5 to 7	COVID	234.01	*1.21*	*-2.26*	1.29	-1.06	1.06
		(0.04)	*(0.01)*	*(0.02)*	(0.00)	(0.02)	(0.00)
	Pre-COVID	234.12	1.38	-4.13	1.24	-1.09	0.99
		(0.04)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
6 to 8	COVID	240.64	*0.88*	*-0.56*	1.03	-0.94	0.99
		(0.05)	*(0.02)*	*(0.03)*	(0.01)	(0.02)	(0.01)
	Pre-COVID	240.97	0.96	-0.95	1.01	-0.89	0.91
		(0.04)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)

Note: * Estimated coefficients for the COVID sample are impacted by the limited sample in the spring of 2020 and should therefore be interpreted with caution. The columns with gains ratios display the rate of growth for the COVID sample divided by the rate of growth for the pre-COVID sample in that time period.

Table 8

Estimated Fixed Effects for Hierarchical Linear Growth Models in Reading for Students in the 90th Percentile and Above

Grade-span	Sample	Intercept	*Year 1 Linear Growth**	*Summer Year 1 Growth**	Year 2 Linear Growth	Summer Year 2 Growth	Year 3 Linear Growth
3 to 5	COVID	212.84	*0.67*	*-0.04*	0.69	-0.28	0.63
		(0.03)	*(0.01)*	*(0.02)*	(0.00)	(0.01)	(0.00)
	Pre-COVID	212.64	0.70	-0.63	0.81	-0.46	0.60
		(0.03)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
4 to 6	COVID	222.58	*0.40*	*-0.04*	0.51	-0.04	0.45
		(0.03)	*(0.01)*	*(0.02)*	(0.00)	(0.01)	(0.00)
	Pre-COVID	222.70	0.50	-0.60	0.63	-0.42	0.49
		(0.03)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
5 to 7	COVID	229.76	*0.25*	*-0.03*	0.39	-0.13	0.42
		(0.04)	*(0.01)*	*(0.02)*	(0.00)	(0.02)	(0.00)
	Pre-COVID	229.98	0.34	-0.81	0.53	-0.29	0.42
		(0.03)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
6 to 8	COVID	235.82	*0.05*	*0.21*	0.27	-0.09	0.37
		(0.04)	*(0.01)*	*(0.02)*	(0.00)	(0.02)	(0.00)
	Pre-COVID	235.64	0.18	-0.32	0.47	-0.09	0.31
		(0.04)	(0.00)	(0.01)	(0.00)	(0.02)	(0.00)

Note: * Estimated coefficients for the COVID sample are impacted by the limited sample in the spring of 2020 and should therefore be interpreted with caution. The columns with gains ratios display the rate of growth for the COVID sample divided by the rate of growth for the pre-COVID sample in that time period.