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Racial differences in parent response to COVID schooling policies

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This paper examines whether school COVID-19 policies influenced enrollment differently by student age and race/ethnicity. Unlike much prior research, we i) analyze enrollments for virtually the entire U.S. public school population for both the 2020–2021 and 2021–2022 school years, ii) compare enrollment trends within districts in order to isolate subgroup heterogeneity from district characteristics, and iii) account for district selection into preferred learning modes. Analyzing data on over 9,000 districts that serve more than 90% of public school students in the United States, we find enrollment responses to COVID policies differed notably. We find that White enrollments declined more than Black, Hispanic, and Asian enrollments in districts that started the 2020–2021 school year virtually, but in districts that started in-person the reverse was true: Non-White enrollments declined more than White enrollments. Moreover, Black, Hispanic, and Asian families responded more than White families to higher COVID-19 death rates in the months preceding the start of the 2021 school year. In 2021–2022, enrollment differences by the previous year's learning mode persisted. Racial/ethnic differences did not vary by whether the district required masking in classrooms. These findings are consistent with the greater risk faced by communities of color during the pandemic and demonstrate an additional source of disparate impact from COVID policies.

COVID-19 | school enrollment | racial disparities

Significance

We find that public school enrollments of different race/ethnicity groups responded differently to COVID schooling policies. Specifically, we find that non-White populations were more likely to disenroll from districts offering in-person schooling in fall 2020. This is consistent with the fact that communities of color faced greater risks from COVID and report less trust in medical and social institutions. Given that prior research finds virtual instruction is associated with lower levels of student achievement, and the fact that enrollment directly determines school district funding, it is particularly important to understand how different racial groups responded to COVID policies.

The COVID-19 pandemic presented school administrators with unprecedented challenges as they sought to balance the twin goals of protecting the health of students and teachers while continuing to provide instruction to millions of children. Ultimately, thousands of districts opted to offer virtual or hybrid instruction during the 2020–2021 school year and thousands required masks during the 2021–2022 school year. Worried about health risks and dissatisfied with the available schooling options, many families pulled their young children from public schools. Indeed, the COVID-19 pandemic led to a 2.8% decline in public school enrollments in fall 2020, the largest single-year decline in US history (1). Enrollments in 2021–2022 remained below prepandemic levels in 73% of districts.

Prior research has explored how school enrollment changed in districts with different COVID policies. Most studies have found larger enrollment declines for younger children and in districts that only offered virtual learning in 2020–2021 (1–3). However, earlier work is limited to a sample of districts, does not thoroughly explore enrollment changes in 2021–2022, and does not systematically study whether enrollment responses to school COVID policies differed across demographic groups.*

In this paper, we re-examine the relationship between COVID schooling policies and student enrollment, with a particular focus on differential responses by race and ethnicity. Given that prior research finds virtual instruction is associated with lower levels of student achievement (4), and the fact that enrollment directly determines school district funding, it is particularly important to understand how different racial groups responded to COVID policies. There are several reasons to suspect such differential responses. First, communities of color faced greater risks from COVID. Age-adjusted COVID-19 mortality rates in 2020 were consistently higher for racial and ethnic minorities than for White residents of the same cities due to a combination of disproportionate underlying comorbidities, greater employment in occupations with less flexibility to socially distance, and a historically discriminatory U.S. public health system (5–7). Second, non-White Americans frequently report lower trust in medical and social institutions in general, are less likely to have health insurance and were more wary of in-person learning during the COVID-19 pandemic (8–10). On the other hand, to the extent that non-White families

*Malkus (1) is the most comprehensive analysis of enrollment changes to date, but the author presents results as associations and does not attempt to control for unobserved factors that may influence enrollment and COVID policy.

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disproportionately worked in occupations that offered less flexibility to work from home, they may have had less ability to manage virtual instruction, and thus an incentive to prefer in-person schooling.

Data and Descriptive Evidence

We combine several public use data sources to construct a sample of districts enrolling more than 90% of all U.S. public school students. We use student enrollment counts from the U.S. Department of Education's Common Core of Data (CCD), restricting our sample to "regular" school districts operating as the region's direct provider of public education. We obtain data on start-of-year learning modes from the COVID-19 School Data Hub (CSDH) and start-of-year mask requirements from the Return to Learn (R2L) tracker (11–13). CSDH defines learning modes as in-person, hybrid, or virtual based on the mode of instruction for the majority of students. In our sample, 27% of districts (enrolling 44% of students) started the 2020–2021 year fully virtual while 44% of districts (enrolling 33% of students) started the 2020–2021 school year in-person. Virtually every school district was in-person to start the 2021–2022 school year; 42% of districts (enrolling 35% of students) started the year without a mask requirement.

We measure pandemic conditions in each school district at the start of the 2020–2021 and 2021–2022 school years. To measure COVID-19 severity, we use county-level COVID deaths per capita from March through August prior to each school year, compiled by The New York Times (14). We also include the county's mask-wearing rate (measured in July 2020) and two-dose vaccination rate for individuals 12 and older (measured in July 2021) to capture local COVID precautions. Finally, we utilize a variety of district-level characteristics meant to capture social, economic, and political factors that could influence COVID policy and public school enrollment changes (see the *SI Appendix, Data Appendix*). Examples include poverty rates, political partisanship, and racial composition.

Raw Enrollment Changes. Enrollment changes varied dramatically across districts (Fig. 1). In 2020–2021, enrollments declined more in Democratic and urban places and in places with

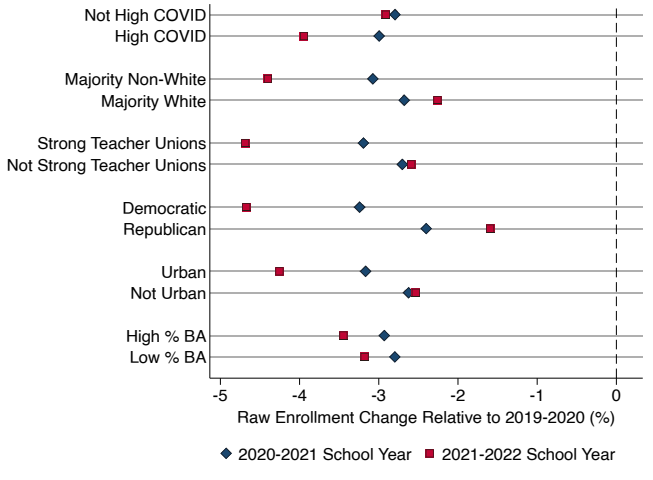

Fig. 1. Distribution of COVID-19 enrollment changes by district characteristics. High COVID is defined as an above-mean county COVID death rate from March–August 2020. Teacher union strength is based on an index from the Fordham Institute (15). Partisanship is based on 2016 presidential election vote shares. Low % BA = districts with less than 25% of adults having a bachelor's degree or more.

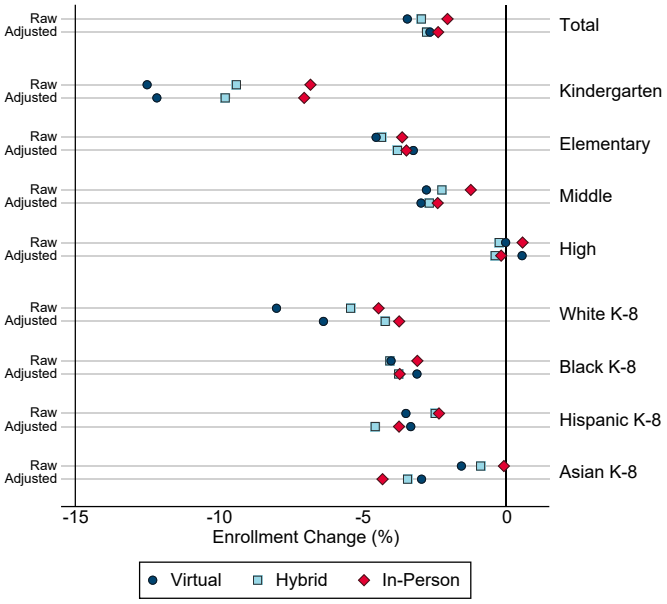

Fig. 2. Change in enrollment from 2019–2020 to 2020–2021. "Raw" changes are average enrollment changes from 2019–2020 to 2020–2021 while "adjusted" changes are relative to pre-existing trends in log enrollments from 2016–2020. Elementary = grades 1–5.

stronger teacher unions, compared to nonurban areas and places with more Republicans and weaker teacher unions. Moreover, these differences grew larger in 2021–2022; for example, urban enrollments declined 3.2% in 2020–2021 relative to 2019–2020 and declined further to 4.3% below pre-COVID levels in 2021–2022, while nonurban enrollments declined by 2.6% in 2020–2021 but recovered 0.1 percentage points of this decline in 2021–2022.

Fig. 2 shows how enrollment changes tracked with school learning mode in 2020–2021. Focusing on the top set of points that measures raw enrollment changes, we see that virtual, hybrid, and in-person districts lost 3.4%, 3.0%, and 2.0% of their 2019–2020 enrollments in the first pandemic school year. That is, as others have noted, districts that only offered virtual instruction saw larger enrollment drops than other districts.

Kindergarten enrollments experienced the largest average declines (10.0%); high school enrollments did not change at all on average. Elementary (grades 1–5) and middle school enrollments declined by 4.2% and 2.2%, respectively. Kindergarten also exhibited the strongest relationship between learning modes and enrollments; enrollments declined 5.7 percentage points more in virtual compared to in-person districts (12.5% vs. 6.8%). Elementary and middle school enrollments also declined more in virtual districts, but differences were smaller.

The bottom of Fig. 2 looks separately by race. We see that White enrollments declined the most (6.0%), followed by Black (3.7%), Hispanic (3.0%), and Asian enrollments (1.2%). Even more interestingly, we see that White enrollments declined substantially more in districts with virtual instruction compared with hybrid or in-person learning (8.0% vs. 4.9%). Black, Hispanic, and Asian enrollments declined slightly more in virtual districts but differences were much smaller.

The raw data in Fig. 2 hint at the differential response of age and racial/ethnic groups to school COVID policies. However, school COVID policies were associated with a host of other social, economic and political differences across districts (see *SI Appendix*, Table S1). The most striking differences between

in-person, hybrid, and virtual districts are demographic and political. The average virtual district was more than twice as large as the average hybrid or in-person district. Virtual districts and those with mask requirements had lower proportions of White students and higher proportions of students eligible for subsidized meals. For example, 38% of students in virtual districts were White compared with 66% in hybrid districts and 55% in in-person districts. Districts offering in-person instruction were more likely to be rural (27%) than those offering hybrid (22%) or virtual (11%) instruction. Finally, virtual districts tended to be more politically liberal; the 2016 Trump vote share in virtual districts was 37% compared with 47% in hybrid and 57% in in-person districts. On the other hand, COVID death rates were similar across districts starting in different learning modes. We observe similar demographic differences between districts that did and did not require masks in fall 2021.

Moreover, state policies also played an important role in determining district policies. For example, Texas and Florida required every district to start in-person in fall 2020 and without masks in fall 2021, while the governors of California and Kentucky required districts to start virtually in fall 2020 in all counties above certain COVID-19 case thresholds (16–19). As exhibited in *SI Appendix*, Fig. S1, this geographic variation resulted in many large, urban districts (like Houston and Orlando) starting fall 2020 in-person and small, rural districts (e.g., in California) starting fall 2020 virtually.

Overview of Research Design

Our goal is to estimate the causal relationship between school COVID policy and student enrollment, with a particular focus on whether the relationship varied by age and race/ethnicity. The key challenge is that COVID policy was associated with a host of pre-existing and COVID-specific factors (*SI Appendix*, Table S1) that may have influenced enrollment directly. We take several steps to mitigate this concern. We summarize these steps here and provide more details in *Materials and Methods* and in *SI Appendix*, *Methods Appendix*.

To begin, we adjust our estimated enrollment declines for pre-COVID enrollment trends, which will be important if districts or specific demographic subgroups were growing at different rates in places that adopted particular COVID policies. Specifically, we estimate the trend in log enrollment for each age and racial group within each district during the 5 y prior to the COVID-19 pandemic (i.e., from 2015–2016 through 2019–2020).[†] We then extrapolate from this pre-COVID trend and calculate the deviation from expected log enrollment in the 2020–2021 and 2021–2022 academic years.[‡]

Enrollment had been growing more slowly (and in some cases shrinking) in virtual districts prior to the pandemic. When we account for this, the gap between virtual vs. in-person districts in terms of changes in total enrollment disappears (Fig. 2). This adjustment also results in substantively different conclusions about how enrollment changed for different racial/ethnic subgroups. For example, while Black enrollment declines were slightly larger in virtual than in-person districts (*Left* panel), when we account for pre-existing trends we find that Black enrollment declined more for in-person (3.7%) than virtual (3.1%) districts. Looking at deviations from trend more generally, it is clear that White enrollments declined more when instruction was virtual while the reverse was true for non-White enrollments.

For our main analyses, we regress these enrollment deviations on COVID learning policies (learning mode in 2020–2021 and mask policy in 2021–2022), controlling for local COVID death rates, masking/vaccination rates, and district and area demographic characteristics. In models of overall district enrollment, we also include state fixed effects to account for state-level enrollment changes that could be correlated with learning modes.[§] In models of specific student subgroups (grade level and race/ethnicity), we include district fixed effects, which ensures we are comparing enrollment changes of different groups within the same district and allows us to disentangle heterogeneity across student types from heterogeneity across district characteristics.[¶] Because local characteristics (e.g., COVID death rates and political partisanship) may have affected enrollments of racial/ethnic groups differently, we control for interactions between all covariates and student race/ethnicity. In race/ethnicity models, we also control for race-specific measures of resources and access to nonpublic schooling options since differences in these characteristics could also lead to different public school disenrollment patterns.

Last, we implement an Instrumental Variable (IV) strategy to address any remaining unobserved factors that might bias our estimates. Our approach leverages the variation in state policies requiring certain learning modes or masking rules, in combination with the documented association between certain district characteristics and subsequent policies. The intuition behind our strategy is that districts that were highly likely to impose virtual instruction (e.g., large school systems with active unions or "blue" districts) were less likely to do so if they were located in "red" states, and vice versa. Importantly, our regression models control directly for the district characteristics that predict learning mode as well as local COVID severity and prevention efforts (all interacted with race indicators), which help satisfy the exclusion restriction in these models.

Results

Model Estimates of Enrollment Changes in 2020–2021. Multivariate regression estimates show that relative to their pre-COVID enrollment trends, districts that started in-person and hybrid experienced smaller enrollment declines in 2020–2021 compared with districts that started virtually. After controlling for social, political, and economic district characteristics, local COVID severity and prevention measures, and state fixed effects, virtual districts experienced an average enrollment decline of 2.7%, compared with declines of 1.4% and 1.9% for in-person and hybrid districts respectively (*SI Appendix*, Table S2, column 6 contains our preferred specification). The relative differences are quite large, with in-person districts experiencing enrollment declines 48% (0.013/0.027) smaller than virtual districts. In comparison to recent US history, these magnitudes are large and

[†] Enrollment for the 2019–2020 school year comes from student counts in October 2019, and thus should not be influenced by COVID.

[‡] Because deviations from trend are usually small, less than 10%, we interpret these as percent-deviations.

[§] For example, the rise of remote work enabled some households to make lifestyle-oriented interstate moves from colder, more expensive states to warmer, cheaper states. Because districts in these states also employed different learning modes and mask policies, these changes would bias our coefficients without the inclusion of state fixed effects (20).

[¶] The prior research is mixed on whether enrollment declines were larger for White or non-White students, with results sensitive to the sample and methodology (3, 21, 22). Moreover, earlier work finds that districts with more Black students may have been less responsive to virtual instruction than districts with fewer Black students (21). However, because Black students attend school districts that are different in many ways than those attended by White students, it is challenging to determine if different enrollment patterns are due to differential responses of Black families or to differential responses of all students in districts with a large proportion of Black families.

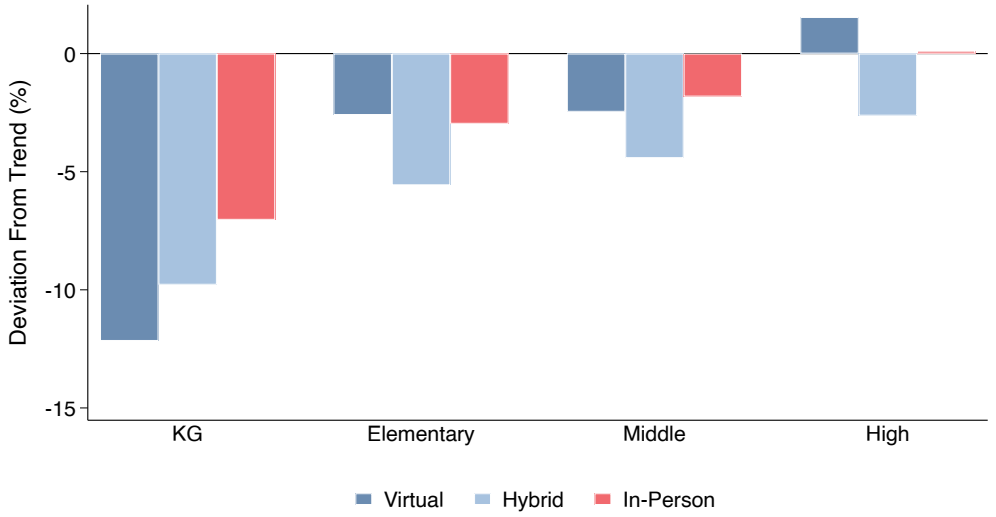

Fig. 3. Predicted 2020–2021 enrollment changes, by district policy and student age. Elementary = grades 1–5. Bar heights represent the predicted deviation for a district with the national average for all control variables. *N* = 36,261 for 9,328 districts with at least 10 students in every grade in every year from 2016 to 2022. See *SI Appendix*, Table S3, column 4 for regression coefficients.

meaningful; only twice in the previous 35 y did public school enrollments decline even 1% year-over-year.

Looking separately by age, we see that kindergarten enrollment responded to learning mode much differently than enrollment in other grades. Fig. 3 shows the predicted enrollment change in 2020–2021 by learning mode and age group based on the model estimates shown in *SI Appendix*, Table S3, column 4. In kindergarten, enrollment declined 43% less in districts with in-person relative to virtual learning (12.2% in virtual compared with in-person declines of 7.0%). In elementary and middle school, the differences in enrollment changes were less consistent and smaller than in kindergarten; high school enrollments changed little. Interestingly, with the exception of kindergarten, our models indicate that enrollment declined the most in districts with hybrid learning mode, suggesting that this "compromise" approach may have been particularly frustrating for families.

As described above, COVID affected racial groups in the United States quite differently because of geographic location, occupation, income levels, and institutional trust. Here, we examine whether these differences translated into school enrollment. We focus on K-8 enrollment; high school enrollment experienced little change during COVID regardless of learning mode, and there were no notable differences by race.

We find White enrollments responded very differently to school learning mode compared with non-White enrollments. Specifically, White enrollments declined more in districts that adopted virtual instruction; the reverse was true for non-White enrollments. Fig. 4 illustrates these differential enrollment responses by plotting the average expected enrollment changes in 2020–2021 separately by race and learning mode, based on the model estimates shown in *SI Appendix*, Table S4, column 4.

White enrollment declined 6.4% when districts were virtual. We estimate Black, Hispanic, and Asian enrollment declines were

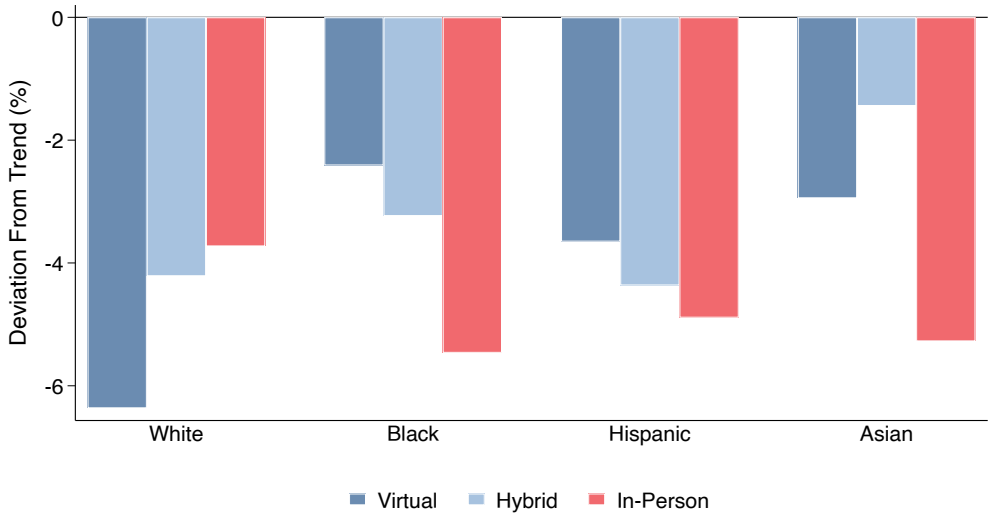

Fig. 4. Predicted 2020–2021 enrollment changes, by district policy and student race/ethnicity. Bar heights represent the predicted deviation for a district with the national average for all control variables. Regressions include one observation per district-race-age group (kindergarten, elementary, middle). *N* = 48,906 observations for 6,876 districts with at least 10 same-age students in two racial/ethnic groups in all years from 2016 to 2022. See *SI Appendix*, Table S4, column 4 for regression coefficients.

roughly one-half this size in the same districts; these differences were statistically significant at the 1% level for Black students and at the 5% level for Hispanic and Asian students. White enrollment declined significantly less in districts with hybrid (4.2% decline) and in-person (3.7% decline) instruction. Black, Hispanic, and Asian enrollment generally declined *more* when districts adopted in-person instruction. For Black and Hispanic students, in-person enrollments declined the most, followed by hybrid and then virtual enrollments. For Asian students, declines in virtual and hybrid districts were not significantly different, but declines were considerably larger for in-person districts.

These differences are large and highly significant ($P < 0.01$; see coefficients on the interaction terms in *SI Appendix*, Table S4). For example, White enrollment declined 2.7 percentage points less when the district adopted in-person learning (relative to virtual) while Black enrollment declined 3.1 percentage points more under the same scenario. Given average K-8 enrollment declines of roughly 4.1%, differences of these magnitudes reflect relative differences of 66–75%.

Why might non-White families be less likely to enroll in public schools that were operating in-person? One reason might be that these families felt COVID represented a bigger threat to their safety. Age-adjusted death rates from COVID-19 were 65% greater among Black and Hispanic individuals compared to Whites (though Asian and White death rates were similar); moreover, the racial disparity in death rates was largest in the early months of the pandemic, the period relevant to our analysis (23).

Enrollment responses to local COVID severity provide additional evidence of greater health concerns in non-White communities. Looking within districts and controlling for the differential effects of learning mode as well as other district characteristics, we find that Black, Hispanic, and Asian enrollment changes in 2020–2021 were more sensitive to local COVID death rates compared with White enrollment. Specifically, a 10% increase in COVID deaths is associated with non-White enrollment declining 0.5-0.7 percentage points more than White enrollment. These results are consistent with the story that non-White families were more cautious when faced with the pandemic's health consequences, and for Asian students that this is true even accounting for similar aggregate community risk compared to White students.[#]

Model Estimates of Enrollment Changes in 2021–2022. While nearly all public schools started the 2021–2022 school year in-person, roughly one-third required students and staff to wear masks in school. Parents who left their local district in the prior year were faced with the decision to re-enroll their child in 2021–2022, or continue with an alternative school arrangement.

We find that the prior year's learning mode as well as the current year's masking policy both influenced district enrollment in 2021–2022. Even after controlling for fall 2020 learning mode (and other covariates) districts without mask requirements saw 2021–2022 enrollment decline 0.8 percentage points (29%) less than those with mask requirements. Interestingly, districts that offered in-person and hybrid instruction in 2020–2021 experienced larger enrollment rebounds than those districts that offered virtual instruction (*SI Appendix*, Table S5), even when controlling for masking policy and other factors. For example, districts that were in-person in 2020–2021 had enrollment declines in 2021–2022 that were 0.8 percentage points (29%) less than districts that were virtual in 2020–2021; hybrid districts experienced declines 0.7 percentage points (25%) less.

In 2021–2022, enrollments remained 2-5 percentage points below trends for K-8 students. We do not identify large age differences in enrollment responses to mask policies in 2021–2022 (*SI Appendix*, Table S6). Notably, Kindergarten enrollments did not rebound in 2021–2022; if the large 2020–2021 declines in K enrollment were due to parents "redshirting" their children for a year, we would expect 2021–2022 enrollments to recover considerably. Instead, it appears that a significant number of families permanently moved toward alternative schooling options.

White enrollments remained 5.6% below prepandemic trends. Non-White enrollments recovered considerably more than White enrollments in districts with and without mask requirements, though the previous year's learning mode differences persisted (*SI Appendix*, Table S7). Our IV specification indicates Black enrollment declined comparatively more in districts without mask policies; however, this result is not robust to the alternative specifications in columns 1–3.

Sensitivity Analyses. We conduct a variety of sensitivity analyses, all of which support the findings above. First, we confirm that our results are robust to i) alternative definitions of learning mode; ii) the sample of districts included in our analysis; and iii) different ways of calculating prepandemic enrollment trends (*SI Appendix*, Tables S8–S10). We also confirm our results are not driven solely by our IV strategy or choice of prepandemic control variables. As we show in *SI Appendix*, Tables S2–S7, the same associations are present in OLS specifications with and without covariates. OLS estimates are smaller in magnitude than the IV estimates, which one would expect if observed learning modes are correlated with unobserved preference for that policy. The OLS estimates suggest that the main difference between White and non-White enrollment changes is how they responded to virtual instruction—namely, White enrollment across all specifications declines substantially more than non-White enrollment in districts with virtual learning.

We found that the enrollment disparities by learning mode we observe in 2020–2021 persisted into the following school year. We confirm this result's robustness by 1) running identical 2020–2021 specifications with 2021–2022 enrollment as the outcome, and 2) omitting summer 2021 COVID death rates from our set of controls in our main 2021–2022 specifications (since COVID death rates could themselves be a function of fall 2020 learning mode decisions); see *SI Appendix*, Table S11.

Because Black and Hispanic students disproportionately enroll in charter schools, we examine whether charter enrollment responded differently to COVID policies than public school enrollment. The data on learning modes in charter schools are not as comprehensive as they are for public districts, and we lack data for charter mask policies, but we find that the learning modes adopted by charters usually match those of the nearby district. Due to the small sample sizes and incomplete data, analysis of charter enrollment changes alone is not informative. Instead, we assign all charter schools to their nearest public district and compare whether regional enrollments responded differently than public enrollments alone. Given that we run these models in a sample of only about 800 districts with any nearby charters,

[#]Note that these estimates do not distinguish between enrollment responses to COVID death rates in different learning modes. In exploratory analyses, we found this negative association is present regardless of the district's initial learning mode. While it may seem surprising that families respond to COVID severity in districts with virtual learning, it is important to recognize the uncertainty surrounding school learning mode at this time. Even in districts that started virtually families may have been concerned about returning to in-person learning at some point during the school year. Moreover, our learning mode–specific estimates are imprecise, and not always significantly different than zero or significantly different across learning modes.

magnitudes should be interpreted with caution; however, our results are unchanged and, if anything, point to stronger learning mode differences by race in charters than in public districts (*SI Appendix*, Table S12).

Finally, non-White Americans are generally more Democratic than the country as a whole. Because partisanship is highly associated with learning mode preferences, these results could theoretically be explained by more Black, Hispanic, and Asian households being Democrats than White households in the same districts. However, our point estimates are similar (albeit with varied statistical precision) when we do not control for district partisanship and when we estimate models in the subset of districts where more than two-thirds of respondents voted for Hillary Clinton in the 2016 election (*SI Appendix*, Table S13). This suggests differential partisanship alone is not enough to explain our findings.

Discussion

This paper examines the association between school COVID-19 policies and enrollment changes, with a particular focus on how responses differed across student subgroups. We document several important findings. First, overall enrollment declines were larger in districts imposing more stringent COVID policies such as virtual-only instruction and mask requirements. Second, enrollment responses to COVID policies differed substantially by age. Not only were enrollment declines larger among kindergarten and elementary children, but the enrollment of students in younger grades was much more sensitive to learning mode. Third, enrollment responses to learning mode differed notably by race and ethnicity. While White enrollments declined more in districts that started the 2020–2021 school year virtually, Black, Hispanic, and Asian enrollments declined more in districts that started the school year in-person. While there is some evidence that Black enrollment declined more than White enrollment in districts with mask optional policies, we do not see a similar difference for Hispanic or Asian enrollments.

Broadly speaking, different enrollment responses across groups could be due to either differences in preferences for learning mode or differences in financial resources or both.[‖] The large differences in how racial/ethnic groups responded to virtual learning we saw in Fig. 2 raise the possibility that resources constraints may be important. That is, it could be that all families would prefer to avoid remote learning, but White families have greater resources which allow them to attend private schools, move, or transfer to another public district. However, these differences persist in models that control for group-specific measures of median household income and poverty rates in the district, suggesting that resources may not be as important as one might have imagined.

On the other hand, several pieces of evidence suggest that differences in preferences for learning mode—particularly preferences due to perceived health risks—were an important determinant of enrollment responses. First, our preferred model estimates suggest that enrollment declines in in-person districts were larger for non-White than White families. Second, we find that non-White enrollments were more sensitive to local COVID severity, even after controlling for learning mode and a host of other district factors. However, it is also possible that these differences in preferences are instead due to other factors, such as the partisan lean of White vs. non-White households as suggested by Kogan (9).

Finally, our results are consistent with survey evidence that Black and Hispanic parents consistently reported greater reluctance to send their children back in-person (9, 24).[**] To the extent that schools serving more Black and Hispanic students have fewer resources, on average, than other schools in the same district, this perception could have some justification.[††] Notably, we observe much smaller racial differences in actual enrollment outcomes compared to preferences expressed in the surveys cited above, demonstrating the importance of economic and geographic constraints (such as a lack of nearby alternative schooling options) on enrollment decisions.

These findings have important implications for the academic achievement of individual students and the fiscal solvency of school districts. Recent studies document significant learning loss among students who attended school virtually during the 2020–2021 school year; these losses persisted at least through the 2021–2022 year (4, 25). If White students who left virtual districts enrolled in charter or private schools that taught their students in-person, or were engaged in a high-quality homeschooling option, the enrollment patterns we document could exacerbate pre-existing racial achievement gaps in these communities (26). Given that school funding is determined by student enrollment, districts with higher proportions of non-White students that maintained in-person instruction during the pandemic will likely face greater fiscal challenges in coming years than in-person districts with a predominantly White student population.

Materials and Methods

Sample Definitions. A total of 13,038 regular U.S. public school districts operated during the 2020–2021 school year. Because our analytic strategy relies on calculating district-specific enrollment trends, we omitted districts with fewer than 10 students per grade per year to avoid overly large year-to-year fluctuations in enrollments. Therefore our sample for 2020–2021 contains 9,328 US school districts. Our sample for 2021–2022 contains 7,255 districts with mask policy data. Finally, for our race/ethnicity analyses, we omit districts with fewer than 10 students of multiple races/ethnicities (White, Black, Hispanic, and Asian) in all age groups. Our sample is highly representative of the U.S. public school population, though by construction our sample for race/ethnicity models is more diverse (*SI Appendix*, Table S14).

Regression Models. Our goal is to estimate the causal relationship between COVID school policies and differences in student enrollment by race/ethnicity. We take steps to address concerns that 1) districts and demographic groups were growing at different rates in places that adopted different COVID policies, 2) COVID policies were associated with other local and state characteristics, and 3) racial and ethnic groups sort nonrandomly across districts in ways that may be correlated with local COVID conditions and policies.

To begin, we estimate the following OLS regression for each district using data from the five school years preceding the pandemic (2015–2016 through 2019–2020):

$$\ln E_{dt} = \alpha_{0d} + \alpha_{1d} t + \varepsilon_{dt}, \quad [1]$$

[‖] In theory, it is also possible that the "cost" of particular COVID policies differs across group within the same district because of, for example, differences in school quality.

[**] Kogan (9) shows that much of this difference can be explained by racial and ethnic sorting across school districts; that is, non-White parents preferred virtual schooling because non-White families tend to live in places that remained virtual for longer. We show that these racial and ethnic differences in preferences exist even within districts.

[††] This finding is also consistent with a lower perceived benefit of in-person instruction among non-White families. However, there is no evidence from academic research or media reports to suggest that this was the case.

where t is a linear measure of academic year. We then calculate each district's log-deviation from its prepandemic enrollment trend:

$$\widehat{\ln E}_{d,Y} = \hat{\alpha}_{0d} + \hat{\alpha}_{1d} \cdot Y, \quad [2]$$

$$\hat{D}_{d,Y} = \ln E_{d,Y} - \widehat{\ln E}_{d,Y}, \quad [3]$$

where $Y = \{2020{-}21, 2021{-}22\}$. We regress $\hat{D}$ for district d in year t on COVID policies and other observable district characteristics:

$$\hat{D}_{d,2020-21} = \alpha_0 + \alpha_1 \text{In-Person}_d + \alpha_2 \text{Hybrid}_d + \alpha_3 \sinh^{-1}(\text{Deaths})_{dt} + \alpha_4 X_{dt} + \gamma_s + \epsilon_{dt}, \quad [4]$$

$$\hat{D}_{d,2021-22} = \alpha_0 + \alpha_1 \text{Mask-Optional}_d + +\alpha_2 \text{In-Person}_d + \alpha_3 \text{Hybrid}_d + \alpha_4 \sinh^{-1}(\text{Deaths})_{dt} + \alpha_5 X_{dt} + \gamma_s + \epsilon_{dt}. \quad [5]$$

In 2021–2022 models, we also control for last year's learning mode, since it is likely correlated with both mask policies and 2021–2022 enrollment deviations. We control for the inverse hyperbolic sine of the total county COVID deaths per 1,000 residents from March through August prior to the academic year; this functional form accounts for the variable's right-skewness. X is a vector of other district characteristics potentially associated with both learning modes and enrollment changes (e.g., partisanship, urbanicity, student poverty rate). γ_s is a state fixed effect, which we include to account for state-level enrollment changes that could be correlated with learning modes. We present results in which we weight each observation by the district's average enrollment in the prepandemic sample years (denoted by N_d) as well as results that are unweighted (*SI Appendix*). We report robust SE.

Instrumental Variables. We develop an IV strategy to address the concern that district policies were correlated with strong (unobserved) preferences among local parents, either regarding the safety of in-person learning or the educational impact of virtual learning (see *SI Appendix, Methods Appendix* for additional details). If these (unobserved) concerns led district leaders to choose policies that families requested, then our estimates of enrollment responses to learning modes and mask policies would be biased toward zero.

Prior research has shown that districts were less likely to offer in-person instruction if they were larger, had stronger teacher unions, had a higher proportion of non-White students, and voted Democratic in the last presidential election (27–29). To capture these factors, we estimate a multinomial logit model predicting whether a district will offer in-person or hybrid instruction in 2020–2021 (relative to virtual instruction) as a function of district demographics and political partisanship:

$$\mathbb{1}\{\text{In-Person}_{ds}, \text{Hybrid}_{ds}, \text{Virtual}_{ds}\} = AX_{ds} + \lambda_s + u_{ds}. \quad [6]$$

We use an identical specification to predict whether districts required masks in 2021–2022:

$$\mathbb{1}\{\text{Mask-Optional}_{ds}, \text{Mask-Required}_{ds}\} = BX_{ds} + \lambda_s + u_{ds}. \quad [7]$$

Using the estimated coefficients from these models (*SI Appendix*, Table S15), we calculate the predicted probability that district d in state s will start in-person or hybrid in fall 2020, or mask-optional in fall 2021.

At the same time, state-level policies imposed different thresholds on COVID cases to open in-person or, in some cases, required certain learning modes or mask rules for all districts (16–19). To capture these policies, for each district we calculate the fraction of other districts in the state which started the year in-person/hybrid or without a mask requirement. We use these two variables as well as their interactions as instruments for learning modes and mask policies. First-stage regressions show that these instruments are strongly associated with actual policies (*SI Appendix*, Table S16).

Student Subgroups. We then estimate Eqs. **1**–**3** for individual student subgroups within a district. This generates measures of the deviation from prior trend for subgroup g in district d in year t, $\hat{D}_{dgt}$, and corresponding enrollment weights N_{dg}. An important advantage of this approach is that it allows us to compare enrollment trends across racial groups within the same school district. For example, to determine whether students of different races/ethnicities respond differently to learning modes, we estimate the following regression:

$$\begin{aligned}\hat{D}_{dg,2021\_22} = {} & \alpha_{1dgt} \text{In-Person}_d \cdot \left[\mathbb{1}\{\text{Black}\}, \mathbb{1}\{\text{Hispanic}\}, \mathbb{1}\{\text{Asian}\}\right] \\ & + \alpha_{2dgt} \text{Hybrid}_d \cdot \left[\mathbb{1}\{\text{Black}\}, \mathbb{1}\{\text{Hispanic}\}, \mathbb{1}\{\text{Asian}\}\right] \\ & + \alpha_{3dgt} \sinh^{-1}(\text{Deaths})_{dt} \cdot \left[\mathbb{1}\{\text{Black}\}, \mathbb{1}\{\text{Hispanic}\}, \mathbb{1}\{\text{Asian}\}\right] \\ & + \alpha_{4dgt} X_{dt} \cdot \left[\mathbb{1}\{\text{Black}\}, \mathbb{1}\{\text{Hispanic}\}, \mathbb{1}\{\text{Asian}\}\right] \\ & + \alpha_{5dgt} \cdot \left[\mathbb{1}\{\text{Black}\}, \mathbb{1}\{\text{Hispanic}\}, \mathbb{1}\{\text{Asian}\}\right] + \delta_d + \epsilon_{dgt}. \end{aligned} \quad [8]$$

Here, the district fixed effect δ_d absorbs the main coefficients for learning mode, COVID deaths, and other area characteristics. White students serve as the reference category, so the coefficients α_{5dgt} represent the difference in enrollment deviations between students in group g in a virtual district relative to White students in the same district, and coefficients α_{1dgt} and α_{2dgt} represent the difference in enrollment deviations between students in an in-person or hybrid district, respectively, and White students in the same district. The interaction terms allow enrollment responses to learning modes, COVID death rates, and district characteristics to vary by race/ethnicity. In these models, we cluster standard errors by district.

Our district-specific and group-specific trends approach has a number of advantages relative to other panel data methods commonly used in the literature. We do not impose a parallel trends assumption implicit in standard differences-in-differences specifications because enrollments for different racial/ethnic groups were trending differently prior to the pandemic, this assumption is clearly violated. Unlike the "comparative interrupted time series" model used in other work studying COVID enrollment changes (21), our method allows enrollment trends to vary within districts in the same treatment status rather than just between statuses. This permits us to study heterogeneity in learning mode preferences and COVID risk aversion holding unobserved district characteristics constant.

Data, Materials, and Software Availability. Data and Code have been deposited in https://www.openicpsr.org/openicpsr/project/194722/version/V1/view (30). All other data are included in the manuscript and/or *SI Appendix*.

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