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## Abstract

A shift to remote and blended learning following pandemic-induced school closures changed the nature of the learning environment for students, leading to changes in the relative importance of educational inputs and their disproportionate impacts on student outcomes by race/ethnicity, gender, and socio-economic status.

In this paper, I explore another dimension of achievement growth differences during the pandemic, student gender. I employ the Blinder-Oaxaca decomposition method to examine how changes in exposure to disruptive peers and gender-based differences in self-control impacted student learning trajectories during the pandemic. I find that differences in students' pre-pandemic self-control explain a moderate share of the observed gender achievement gaps. Also, math achievement gaps widened for those who remained remote, whereas there were no significant gaps for those returned to school.

## Introduction

Two years after the COVID-19 pandemic broke out, concerns over short-term and long-term impacts of learning disruption have remained prevalent among education experts. Concerns are also raised that it might have exacerbated pre-existent achievement gaps by race/ethnicity, gender, and socio-economic status.

As schools switched their learning mode from traditional face-to-face instruction to remote instruction after the pandemic broke out, the pandemic-induced school closures and the consequent shift in learning mode are believed to affect a range of educational inputs that are relevant for the process of skill formation of children.

$$A_{it} = f(S_i(t), P_i(t), X_i(t), F_i(t), I_{i0}, \epsilon_{it})$$

Based on the pandemic-induced shifts in learning environment and the evidence from the existing literature, I propose two hypotheses as potential explanations for the observed gender achievement gaps in the school district I study: (i) remote instruction changed the nature of peer interactions and girls were less disrupted by their mis-behaving peers during remote learning after initial school closures in mid-March of 2020, and (ii) girls are better at self-control, which is an essential component of success in remote learning, and thus learned more than boys did when schools were closed<sup>1</sup>.

Figure 1. Timeline of School Closure and iReady Diagnostic Testing Windows

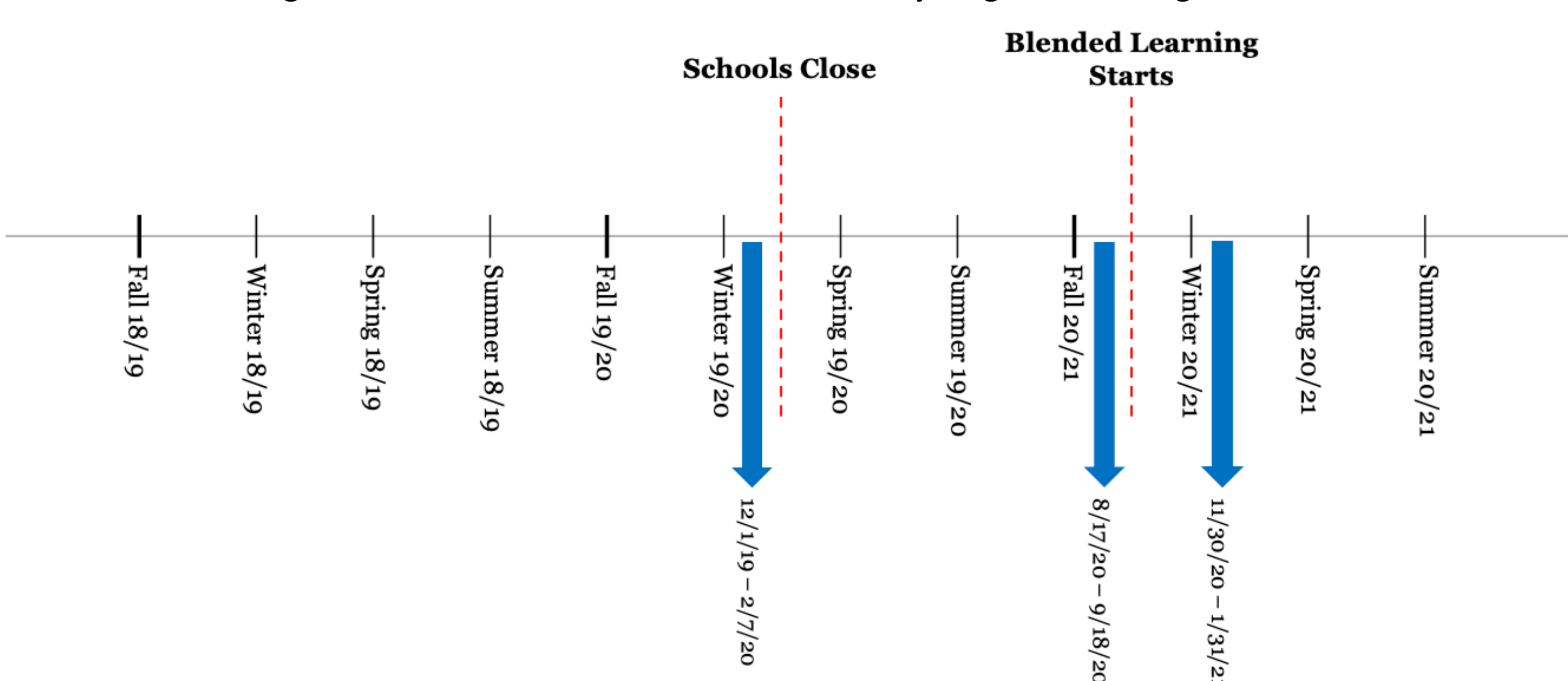
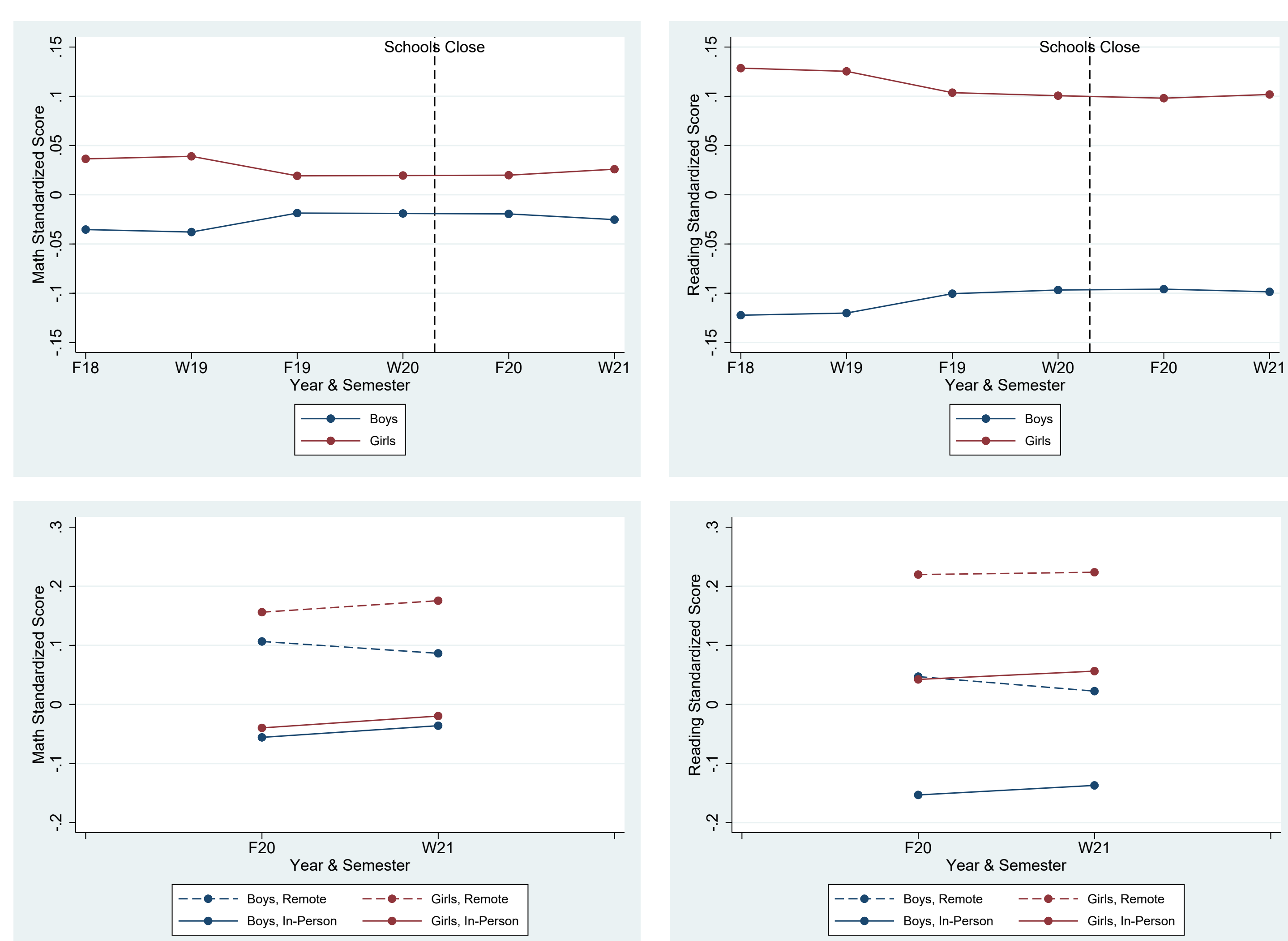


Figure 2. Standardized iReady Assessment Score Trends, Full Sample and by Learning Mode



## Methodology

I use administrative data of a metro-Atlanta school district and exploit the variation in the intensity of classroom disruptiveness, self-control level, and the proportion of instructional remote learning days by gender.

$$y_{igst} = \beta_0 + \beta_1 female_i + \beta_2 prop.d_{igst} + \beta_3 ever.rush_{igst} + \beta_4 y_{igst-1} + \beta_5 y_{igst-1}^2 + \beta_6 X_{igst} + \lambda_g + \sigma_s + \tau_t + \epsilon_{igst}$$

$$\Delta \bar{y}_t = \bar{y}_t^G - \bar{y}_t^B = (\beta_0^G - \beta_0^B) + [\alpha_1(\Delta \overline{prop.d}_t) + \alpha_2(\Delta \overline{prop.d}_t^B) + \alpha_2(\Delta \overline{prop.d}_t)] + [\alpha_3(\Delta \overline{ever.rush}_t) + \alpha_4(\Delta \overline{ever.rush}_t^B) + \alpha_4(\Delta \overline{ever.rush}_t)]$$

In order to explore the trend in the gender achievement gaps and estimate the change in the magnitude of impacts of exposure to disruptive peers and self-control level across gender over the course of the pandemic, I apply the Blinder-Oaxaca decomposition method. I investigate whether changes in gender achievement gaps during the pandemic-induced remote learning stemmed from the two mechanisms of interest. To overcome potential selection bias resulting from parental choice of learning mode for their kids in the Fall of SY 2020-21, I use Two-Stage Least Squares (2SLS) method and employ instrumental variables.

Table 1. Blinder-Oaxaca Decomposition Results by Phase and Learning Mode

	Pre-Pandemic		Unplanned Remote		Planned Remote		Remote		In-Person	
	OLS	OLS	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Gender Achievement Gap ( $\bar{y}_t^G - \bar{y}_t^B$ )	0.0340 (0.0074)	0.0654 (0.0109)	0.0498 (0.0123)	0.0414 (0.0127)	0.0847 (0.0186)	0.0800 (0.0191)	0.0141 (0.0162)	0.0013 (0.0170)		
Gap due to Mean Differences $\alpha_1(\Delta \overline{prop.d}_t)$	0.0016 5%	0.0007 1%	0.0006 1%	0.0004 1%	-0.0001 0.1%	-0.0001 0.1%	0.0013 9%	0.0009 6%		
Gap due to Mean Differences $\alpha_2(\Delta \overline{ever.rush}_t^B)$	0.0038 11%	0.0060 9%	0.0066 13%	0.0061 15%	0.0049 6%	0.0044 6%	0.0082 58%	0.0076 58%		
Gap due to Coefficient Differences $\alpha_2(\Delta \overline{prop.d}_t^B)$	0.0004 1%	-0.0039 6%	0.0030 6%	0.0029 7%	0.0034 4%	0.0053 7%	0.0030 21%	0.0013 100%		
Gap due to Coefficient Differences $\alpha_4(\Delta \overline{ever.rush}_t^B)$	0.0021 6%	-0.0084 13%	-0.0041 8%	-0.0051 12%	-0.0127 15%	-0.0146 18%	0.0046 33%	0.0044 338%		
Gap due to coefficient differences of Proportion of Remote Learning			0.0307 62%	0.0255 62%						
N	69,763	32,409	26,179	23,857	12,474	11,683	13,705	12,174		

## Results

Analyses during pre-pandemic in-person instruction (not presented in this poster) indicate that being exposed to historically disruptive peers and a lack of personal self-control negatively affect student achievement and that girls are disproportionately negatively impacted by lacking self-control, compared to boys.

Main analyses results suggest that disruptive peers and self-control continue to be significant determinants of student achievement over the course of the pandemic, and students' pre-pandemic self-control level can explain a moderate share of the observed gender achievement gaps where the gaps favor female students. Moreover, I find large gender achievement gaps in math for those who stayed remote between the fall and winter exams of SY 2020-21, whereas no statistically significant gender gaps were found among those returned to school.

## Discussion & Conclusions

The COVID-19 pandemic and the school closures has undoubtedly affected many aspects of people's lives. Especially for students, the pandemic-induced shift to remote learning has unprecedentedly altered the nature of their learning environment. Since the initial onset of the pandemic, remote learning has received great attention and the importance of self-regulated learning has been stressed ever than before.

Accumulating evidence on disproportionate impact of the pandemic-induced remote learning by gender as well as race/ethnicity and SES raise serious concerns and questions on how best to provide targeted, needed support for distinct student subgroups.

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## References

1. Duckworth, A. L., & Seligman, M. E. (2006). Self-discipline gives girls the edge: Gender in self-discipline, grades, and achievement test scores. ; Han, L., & Li, T. (2009). The gender difference of peer influence in higher education. ; Ficano, C. C. (2012). Peer effects in college academic outcomes – gender matters! ; Duckworth, A. L., Shulman, E. P., Mastrorarde, A. J., Patrick, S. D., Zhang, J., & Druckman, J. (2015). Will not want: Self-control rather than motivation explains the female advantage in report card grades.