Technical Appendix for
The COVID-19 slide: What summer learning loss can tell us about the potential impact of school closures on student academic achievement

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Introduction

In a recent NWEA Research white paper, Kuhfeld and Tarasawa (2020) present a series of growth projections based on MAP® Growth™ data from the 2017-18 school year. In this document, we outline the methodology behind the projections. Further details on the data used and analyses conducted can be found in Kuhfeld and Soland (2020).

Data

The data for this study are from NWEA's anonymized longitudinal student achievement database. School districts use NWEA's MAP Growth assessments to monitor elementary and secondary students' reading and math growth throughout the school year, with assessments typically administered in the fall, winter, and spring. In the white paper, we use the test scores of over five million third- to eighth- grade students in 16,824 schools from across the United States in the 2017-18 school year. Tables 1 and 2 in Kuhfeld and Soland (2020) provide a description of the students in the sample and a comparison of NWEA partner schools relative to US population of public elementary and middle schools.

Student test scores from NWEA's MAP Growth reading and math assessments are used in this study. MAP Growth is a computer adaptive test—which means measurement is precise even for students above or below grade level—and is vertically scaled to allow for the estimation of gains across time. Test scores are reported on the RIT (Rasch unIT) scale, which is a linear transformation of the logit scale units from the Rasch item response theory model.

Typical Growth and Summer Loss Estimation

To quantify typical growth rates across a standard-length (9.5-month) school year, we estimated a series of multilevel growth models (test scores across fall/winter/spring are nested within students within schools). As described in further detail in Kuhfeld and Soland (2020), we found evidence of non-linearity in students' school-year growth rates, and therefore chose to use a quadratic growth model to produce typical growth projections. In this model, the test score y_{tij} for student *i* in school *j* at timepoint *t* is modeled as a quadratic function of the months (Months_{tij}) that a student has been in school at the time of testing:

Level-1 Model (timepoint (t) within student (i) within school (j)):

$$\mathrm{y}_{tij} = \pi_{0ij} + \pi_{1ij}\mathrm{Months}_{tij} + \pi_{2ij}\mathrm{Months}_{tij}^2 + e_{tij},$$

Level-2 Model (student (i) within school (j)):

$$\pi_{0ij} = \beta_{00j} + r_{0ij}$$
$$\pi_{1ij} = \beta_{10j} + r_{1ij}$$
$$\pi_{2ij} = \beta_{20j} + r_{2ij}$$

Level-3 Model (school (j)):

$$\beta_{00j} = \gamma_{000} + u_{00j}$$
$$\beta_{10j} = \gamma_{100} + u_{10j}$$
$$\beta_{20j} = \gamma_{200} + u_{20j}$$

In this model, γ_{000} is the average test score on the first day of school, γ_{100} is the average instantaneous rate of change at the start of the school year, and γ_{200} is the average rate of change of the linear growth term for a one-month change in time (e.g., the acceleration or deceleration in growth). This model was estimated separately by subject (math and reading) and grade (3-8). Growth parameters are presented in Table 5 of Kuhfeld and Soland (2020). Based on these parameters, typical growth rates from the start of the school year (Months=0, which we assume to be September1st) to the end of the school year (Months=9.5, roughly June 15th) are plotted in the white paper. Average overall total growth estimates from the start to end of the school year are presented in Table A1 on page 4 of this Appendix.

Typical summer loss rates were calculated by following a subset of students from the 2017-18 school year into the subsequent grade (the fall of 2018). Since most students did not test at the very end of school year, model-based projections of students' test scores to the end of the spring 2018 school year were used in the summer loss calculations. Average total summer loss (assuming a 2.5-month summer) in RIT points are reported in Table A1.

COVID-19 Slowdown and Slide

In the research brief, we consider two possible scenarios for the potential impact of COVID school closures on student learning. The first scenario, *COVID Slowdown,* assumes that students would end the school year at the achievement level they were at when schools closed (using March 15th as the school closure date, which would correspond to 6.5 months of school). This scenario is based on work by von Hippel and colleagues (2018) using the ECLS-K data, which indicates that achievement does not drop but rather flattens during the summer. To produce COVID Slowdown estimates, we estimate the achievement level at 6.5 months based on the quadratic model parameters for each subject/grade and that achievement level is treated as constant for the remaining three months of school and through the summer.

The second scenario, *COVID Slide*, assumes that students would show typical summer loss patterns during the extended school closure. In this scenario, we use the same achievement level at 6.5 months as the starting point for the projection, but then assume students lose ground from that point at a standard monthly summer loss rate (by subject and grade). Monthly summer loss rates are calculated by dividing the overall summer loss estimates in Table A1 by 2.5 months. Linear COVID Slide projections are made from school closure (6.5 months, March 15th) to the end of the school year (9.5 months, June 15th) and extend to the presumed start of the next school year (12 months, September 1st). During the "normal" summer period (9.5 to 12 months), the typical summer loss and COVID Slide rates are the same, and so these lines are parallel in the figures.

Calculating Projected Gains

In addition to the figures displaying the growth projections in the white paper, we also report the magnitude of COVID Slide drops as a percentage of learning gains that students are expected to retain relative to a typical school year. These percentages are calculated by estimating the total gains under the COVID Slide assumption relative to the total gains expected under typical growth. Figure A1 displays an illustration of the relevant pieces of information for these calculations for third-grade mathematics. Total gains in the school year under the COVID Slide scenario can be calculated as 195 – 187 = 8 RIT points, whereas typical gains would be 203 – 187=16 RIT points. Therefore, in third-grade mathematics we would assume that students could end the school year with 8/16=50% of the learning gains relative to a typical school year.

Limitations

These projections represent a starting point for conversations around the impact of COVID-19 school closures on learning. The school closures caused by COVID-19 likely have additional aspects of trauma to students, loss of resources, and loss of opportunity to learn that go well beyond a traditional summer break for many families. It is unlikely that historic summer loss patterns capture the myriad of challenges that students and schools are encountering during this period. Nonetheless, we hope these preliminary forecasts will serve as a useful benchmark to begin to think through the learning patterns that may be expected when students return to school in the fall.

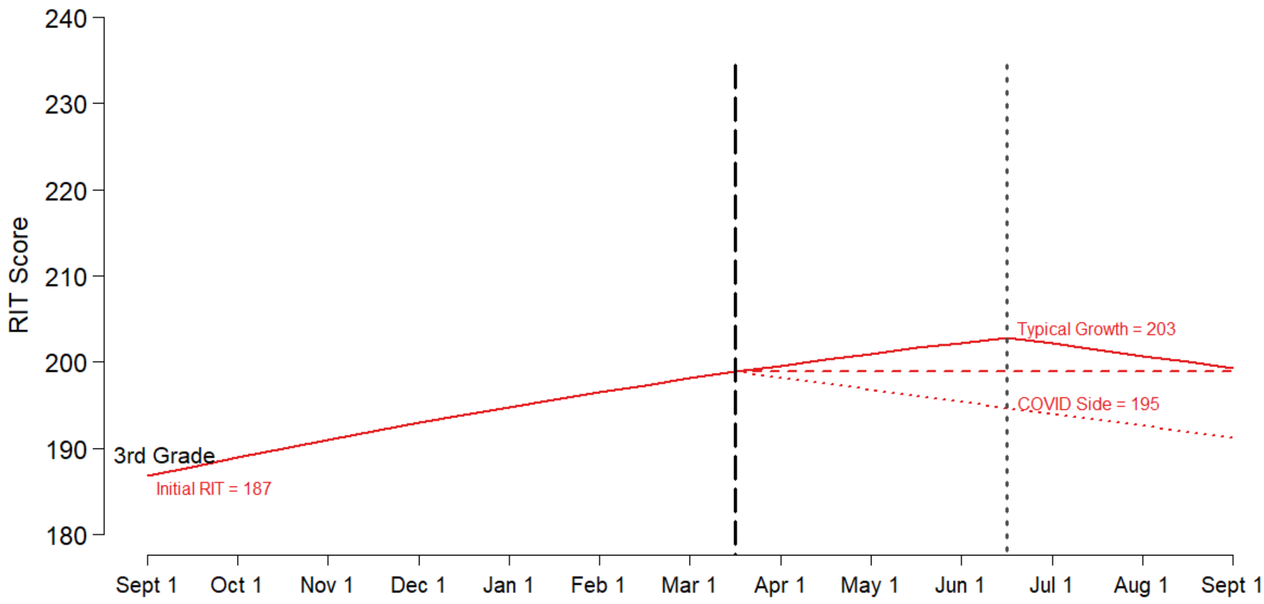
Tables and Figures

Table A1: Results from the growth projections and summer loss models

Grade	Subject	Initial Fall Score	Total Fall-Spring Growth	Average Summer Drop
3	Math	186.74	16.09	-3.51
4	Math	199.09	13.69	-3.81
5	Math	208.46	12.23	-5.00
6	Math	212.56	9.98	-2.63
7	Math	219.06	8.05	-1.92
8	Math	224.42	6.83	-1.22
3	Reading	185.42	12.77	-1.65
4	Reading	196.00	9.33	-1.20
5	Reading	203.39	7.49	-1.31
6	Reading	208.36	5.92	-0.91
7	Reading	212.77	4.83	-0.37
8	Reading	216.57	4.09	-0.16

Note. Total Fall-Spring Growth represents the total growth between 0 to 9.5 months of school under the quadratic model. Average Summer Drop is the average RIT drop across the summer months (Fall 2018 RIT minus Spring 2018 RIT), which is calculated using projected scores that adjust scores to remove the impact of instructional time that occurred after testing in the spring and before testing in the fall. The summer drop reported for each grade represents the summer following the grade (e.g., grade 3 summer drop is for the summer between third and fourth grade).

Figure A1*: Illustration of the percentage of learning gains calculations for third grade mathematics*



References

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