Contribution of Pathways of Progress™ to Predicting Later Reading Outcomes

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Introduction

Progress monitoring decisions are a critical part of Response-to-Intervention models. These decisions, which are based upon formative assessment data are a hallmark of effective multi-tiered systems of support. In addition, student outcomes are enhanced when meaningful, ambitious, and attainable goals are established (effect size +0.56); when feedback is provided to students and teachers on progress relative to goals (effect size +0.73); and when progress monitoring and formative evaluation with goals, graphing, and decision rules are employed (effect size +0.90) (Fuchs & Fuchs, 1986; Hattie, 2009).

Defensible progress monitoring requires an interpretive framework for determining adequacy of progress and accurate measurement of individual student skill. Furthermore, progress decisions should be reliable, valid, and result in improved outcomes. Ongoing concerns about the manner in which academic progress is judged has been expressed in the literature. For example, Ardoin, Christ, Morena, Cormier, and Klingbeil (2013) have stated the following:

> *The conclusion across multiple studies seems apparent: CBM-R progress monitoring is not an evidence-based practice for modeling growth of individual students' gains in reading. Substantial research is necessary to guide progress monitoring implementation, if it is to be established as an evidence-based practice (p. 12).*

These authors called "for research to develop, evaluate, and establish evidence-based guidelines for use and interpretation of CBM-R short-term progress monitoring data" (p. 14).

Good decisions regarding student progress are ones that enable educators to improve outcomes for students. Such decisions exhibit the following characteristics: they (1) provide timely information to inform instruction; (2) are reasonably stable and reliable; (3) provide instructionally relevant information for individual students; (4) provide instructional relevant information at a systems level to inform classroom instruction.

DIBELS Next® Pathways of Progress™ offers a means of indexing student progress that can be used to evaluate the effectiveness of instruction, establish meaningful, attainable, and ambitious goals, and provide feedback on progress to students and educators. Pathways of Progress is based upon student growth percentiles. Student growth percentiles provide a measure of "how (ab)normal a student's growth is by examining their current achievement relative to their academic peers—those students beginning at the same place" (Betebenner, 2011, p. 3).

Pathways of Progress is based on an analysis of students across grades K–6 whose DIBELS Next scores were entered in DIBELSnet®, VPort®, or mCLASS® data systems (N ≈ 1.8 million students). The Pathways are calculated in a three-step process:

1. At each grade level, students were grouped by their beginning-of-year DIBELS Composite Score (BOY DCS) for scores between the first and the 99.5th percentile rank. For each unique BOY DCS, the 20th, 40th, 60th, and 80th quantiles were calculated for the end-of-year DIBELS Next measure or DCS.
2. A stiff spline quantile regression model was fit to each quantile using BOY DCS as the predictor (mean RMSE = .99 for all grades).
3. The predicted quantile scores from the regression model corresponding to each unique BOY DCS were rounded to the nearest one, forming the end-of-year pathway borders.

After end-of-year benchmark administration, each student's score will fall into a single pathway based on the expectation of progress from their beginning-of-year score (Pathway 3 = Typical Progress).

Purpose

Previous research examining the decision reliability for two progress decision metrics indicated that Pathways of Progress resulted in more reliable decisions than the use of slope and ROI norms (Good & Powell-Smith, 2015; Good, Powell-Smith, Gushta, & Dewey, 2015). In addition, reliable decisions were possible as early as the 6th week of data collection. It is important to extend this previous work to focus on the impact of Pathways of Progress on longitudinal academic outcomes. As such, this study examined the predictive validity of Pathways of Progress with respect to later reading outcomes.

Research Questions

1. For grades K–5, what is the probability associated with different levels of progress (DIBELS Pathways of Progress) in achieving future outcomes given the level of initial skills (beginning of year DCS) for students right at the benchmark goal?
2. For grades K–5, what is the probability associated with different levels of progress (DIBELS Pathways of Progress) in achieving future outcomes given the level of initial skills (beginning of year DCS) for students right at the cut point for risk?
3. What is the amount of additional variance accounted for by Pathways of Progress over and above initial skills when predicting student outcomes in subsequent grades?

Method

Participants included a grade K–1 cohort of 36,022 students, a grade 1–2 cohort of 29,846 students, a grade 2–3 cohort of 25,266 students, a grade 3–4 cohort of 21,341 students, a grade 4–5 cohort of 20,185 students, and a grade 5–6 cohort of 10,254 students. All students in DIBELSnet, VPort and mCLASS data systems with complete DIBELS Next data for beginning-, middle-, and end-of-year assessments were included in the data set used for analysis.

The independent variables were (a) the student's level of initial skill represented by the DIBELS Composite Score at the beginning of the year, and (b) an indicator variable for the student's individual Pathway of Progress over the course of the year. The dependent variables were (a) for all cohorts, the beginning-of-the-following year DIBELS Composite Score, and (b) for the K–1 cohort, the end-of-first grade DIBELS Composite score.

Student progress from the beginning of year to the beginning of year of the next grade level was assessed through logistic regression models. We evaluated the difference in the probability of meeting the next grade-level benchmark goal between each Pathway. Additionally, the proportion of variance in the outcome (e.g., subsequent grade beginning of year DCS) that was explained by the student's beginning of year benchmark status and their end of year Pathway of Progress was calculated from a series of multiple regression models at each grade level. Finally, the amount of additional variance explained by Pathways being added to the model beyond that explained by BOY DCS alone was examined.

Results

Odds of Being On-Track in Subsequent Grade

The logistic regression curves for grades K–5 (*Figures 1–7*) show the probability of achieving the DCS benchmark goal at the subsequent grade level is significantly different for students on different end-of-year Pathways in their current grade level. Moreover, the probability of achieving benchmark on the DCS is progressively higher across the ordinal Pathways (e.g., probability is greater for students on Pathway 4 than for Pathway 3, etc). These logistic regression curves include interactive effects where present. The sample sizes are reported for each grade in *Figures 1–7*. Probability data based on these analysis for Pathways 1, 3, and 5 are summarized *Tables 1* and *2*. Finally, the amount of variance explained by the full model (i.e., Nagelkerke R^2) and additional variance explained by Pathways for each grade level and outcome examined is reported in *Table 3*.

Figure 1. Grade K Predicting Beginning-Of-Year Grade 1

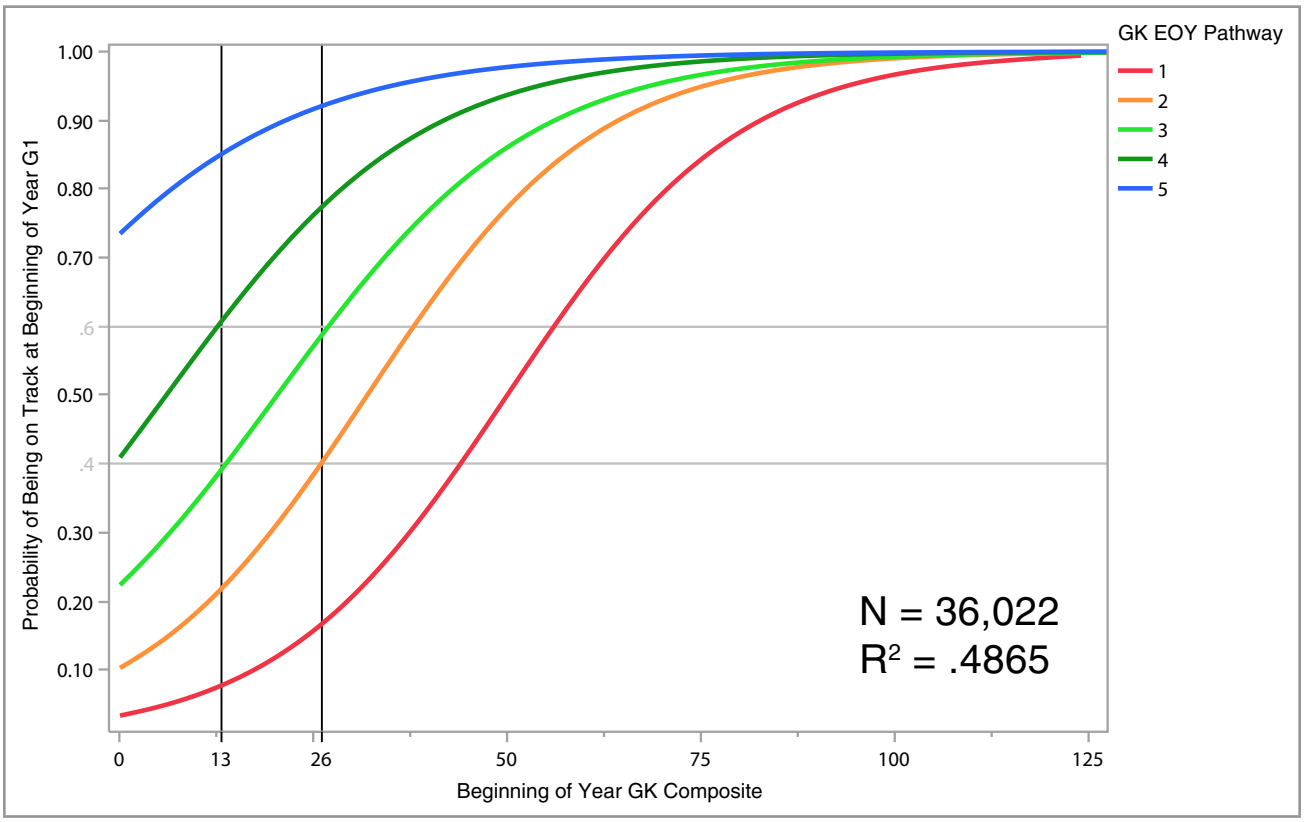

Figure 2. Grade K Predicting End-Of-Year Grade 1

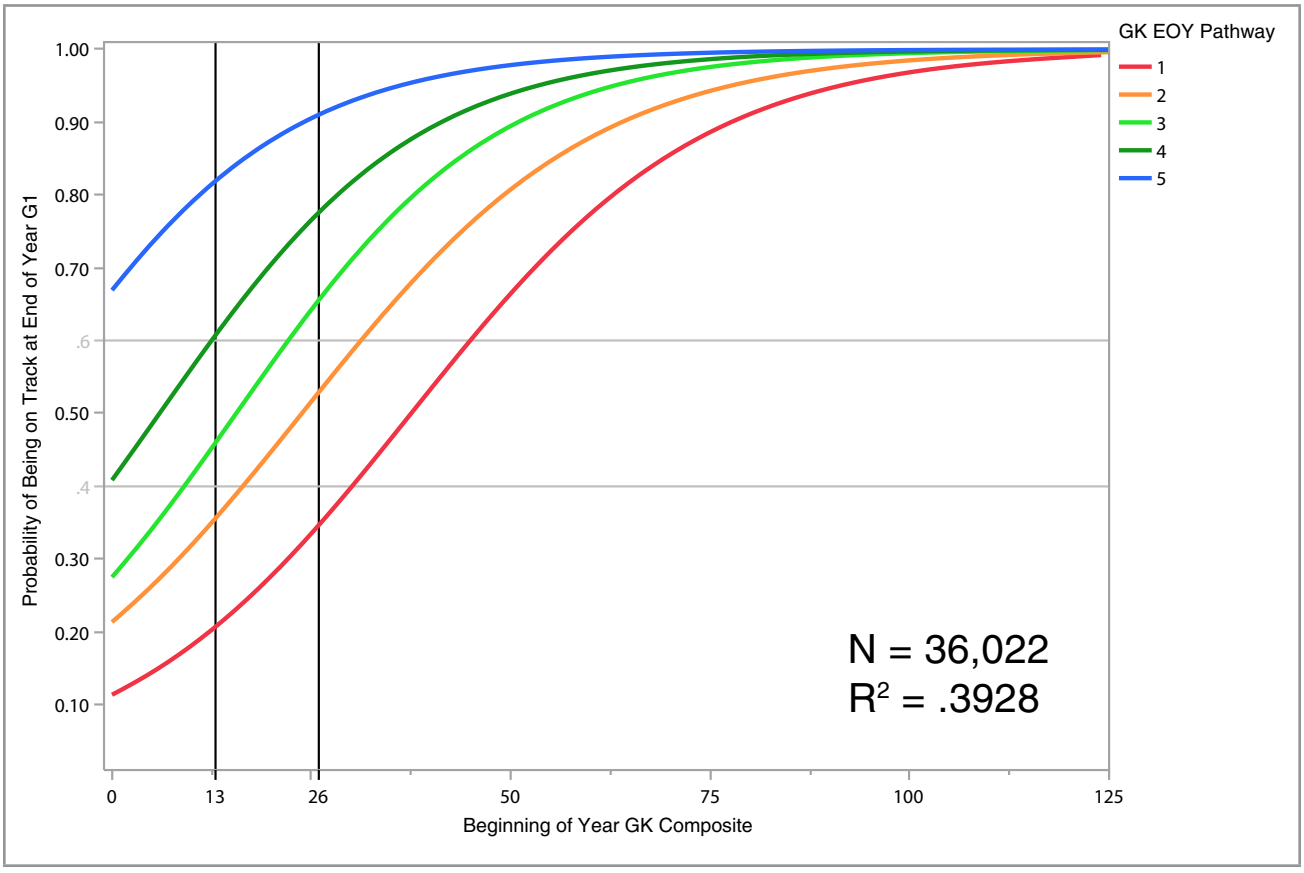

Figure 3. Grade 1 Predicting Beginning-Of-Year Grade 2

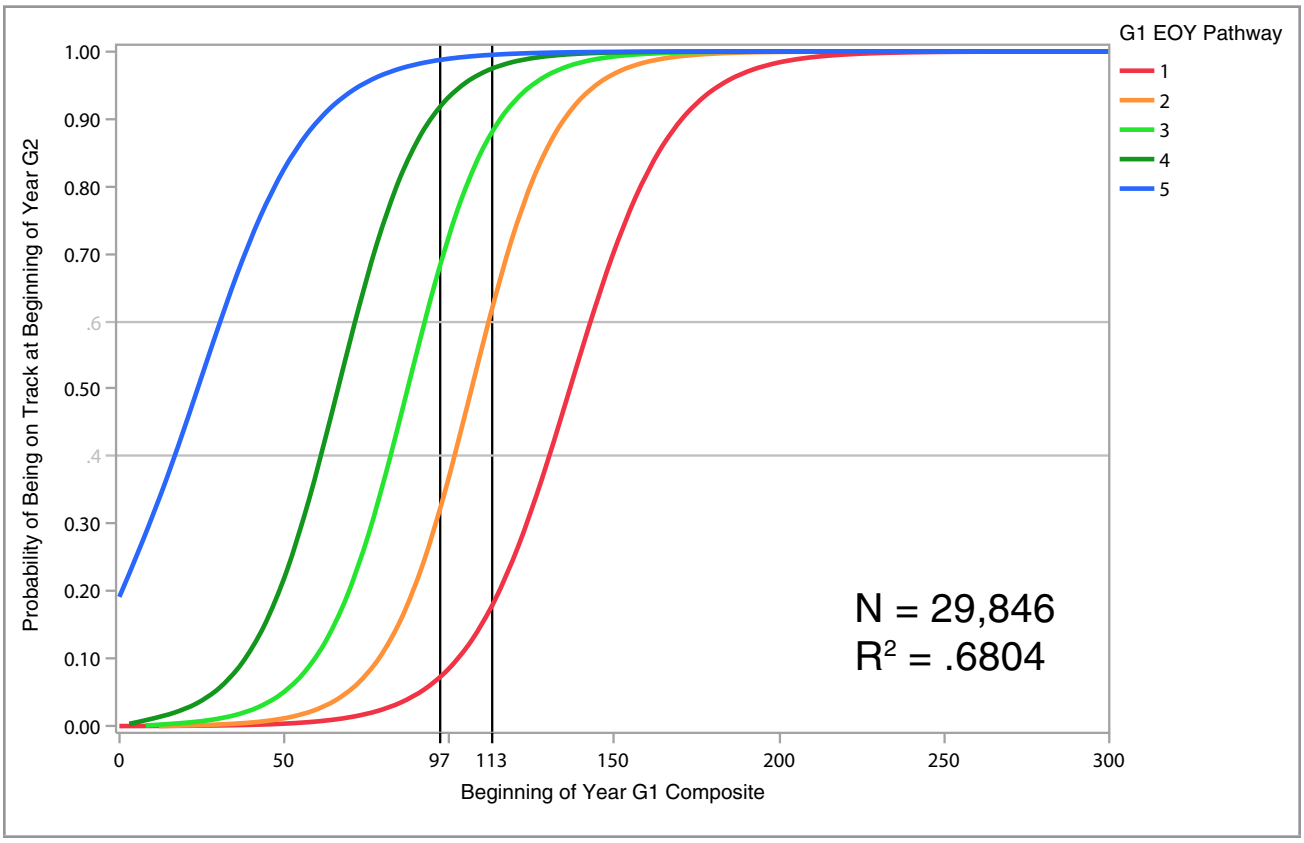

Figure 4. Grade 2 Predicting Beginning-Of-Year Grade 3

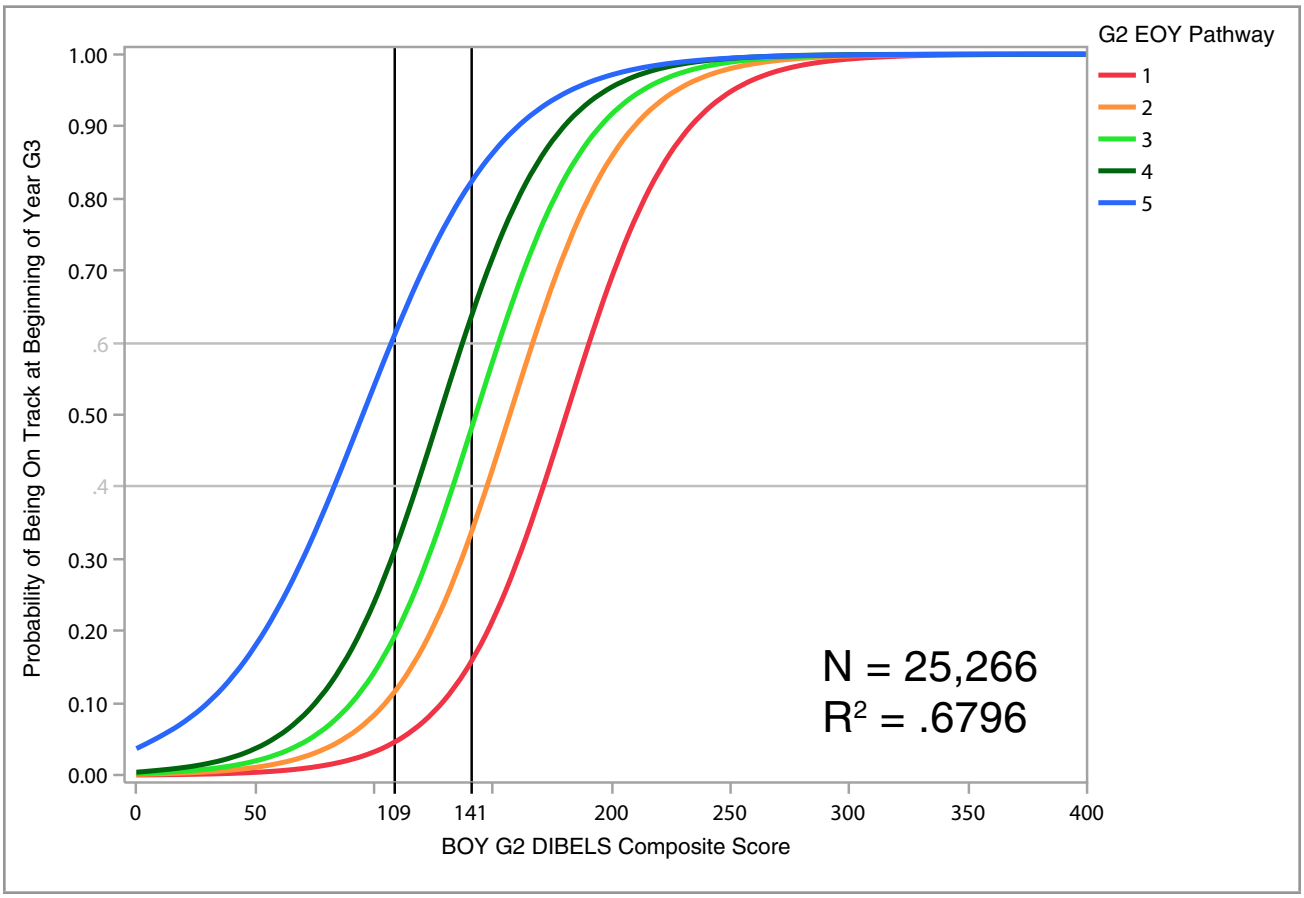

Figure 5. Grade 3 Predicting Beginning-Of-Year Grade 4

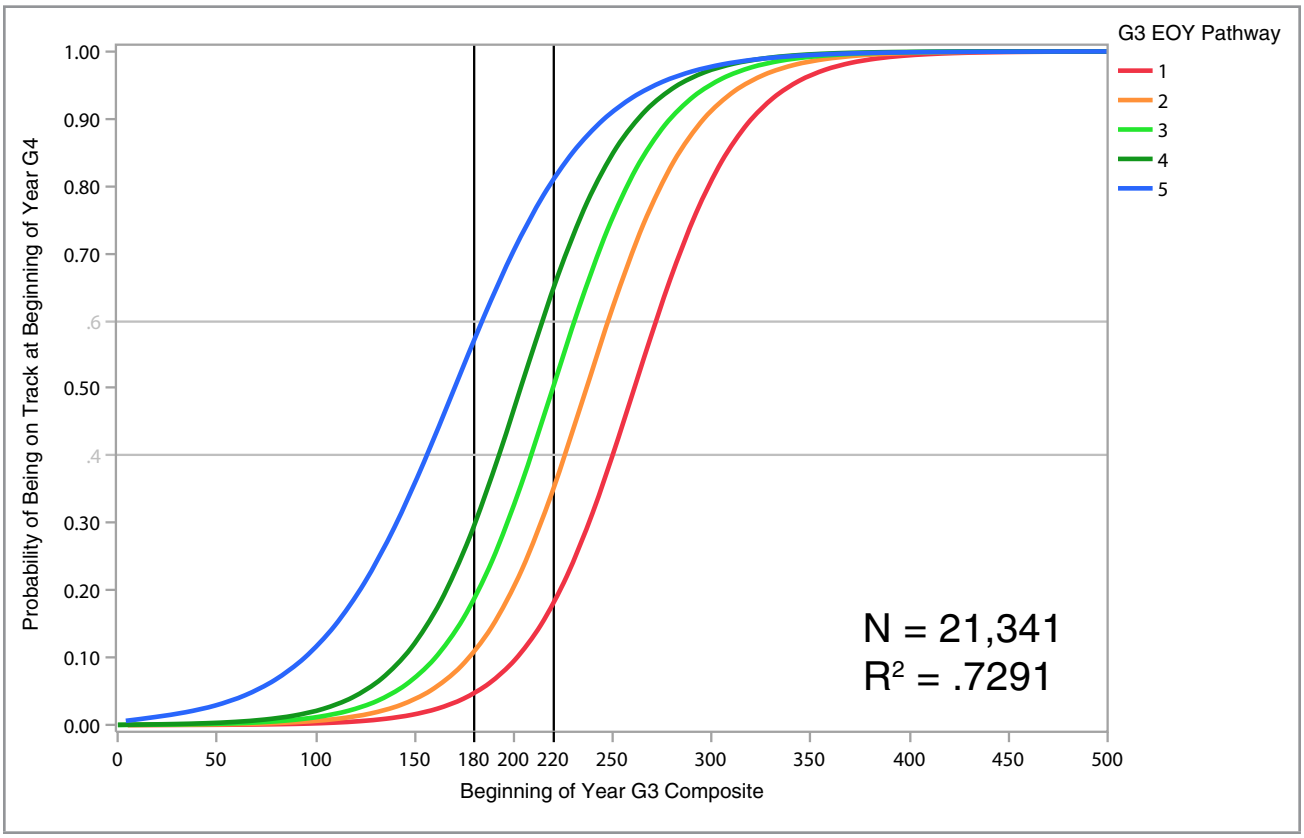

Figure 6. Grade 4 Predicting Beginning-Of-Year Grade 5

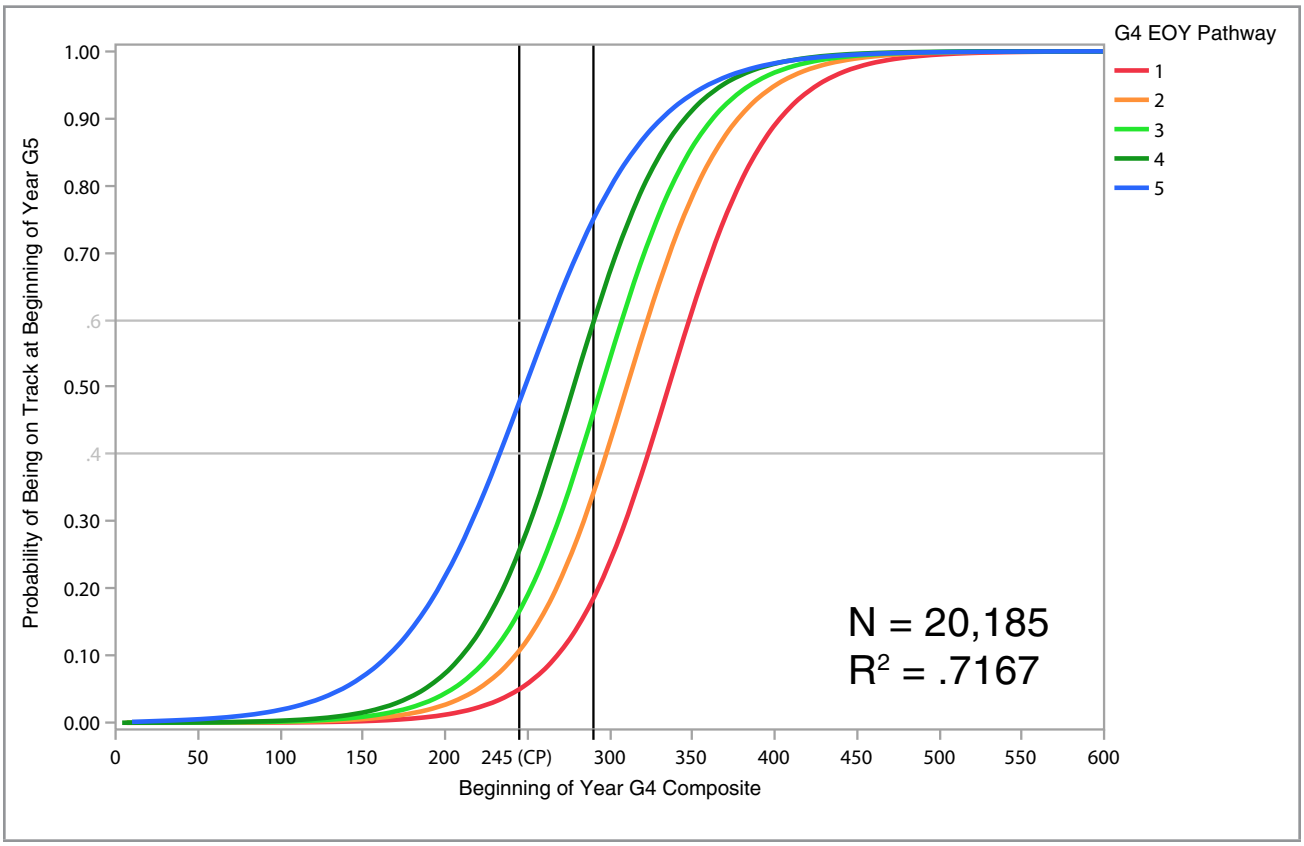

Figure 7. Grade 5 Predicting Beginning-Of-Year Grade 6

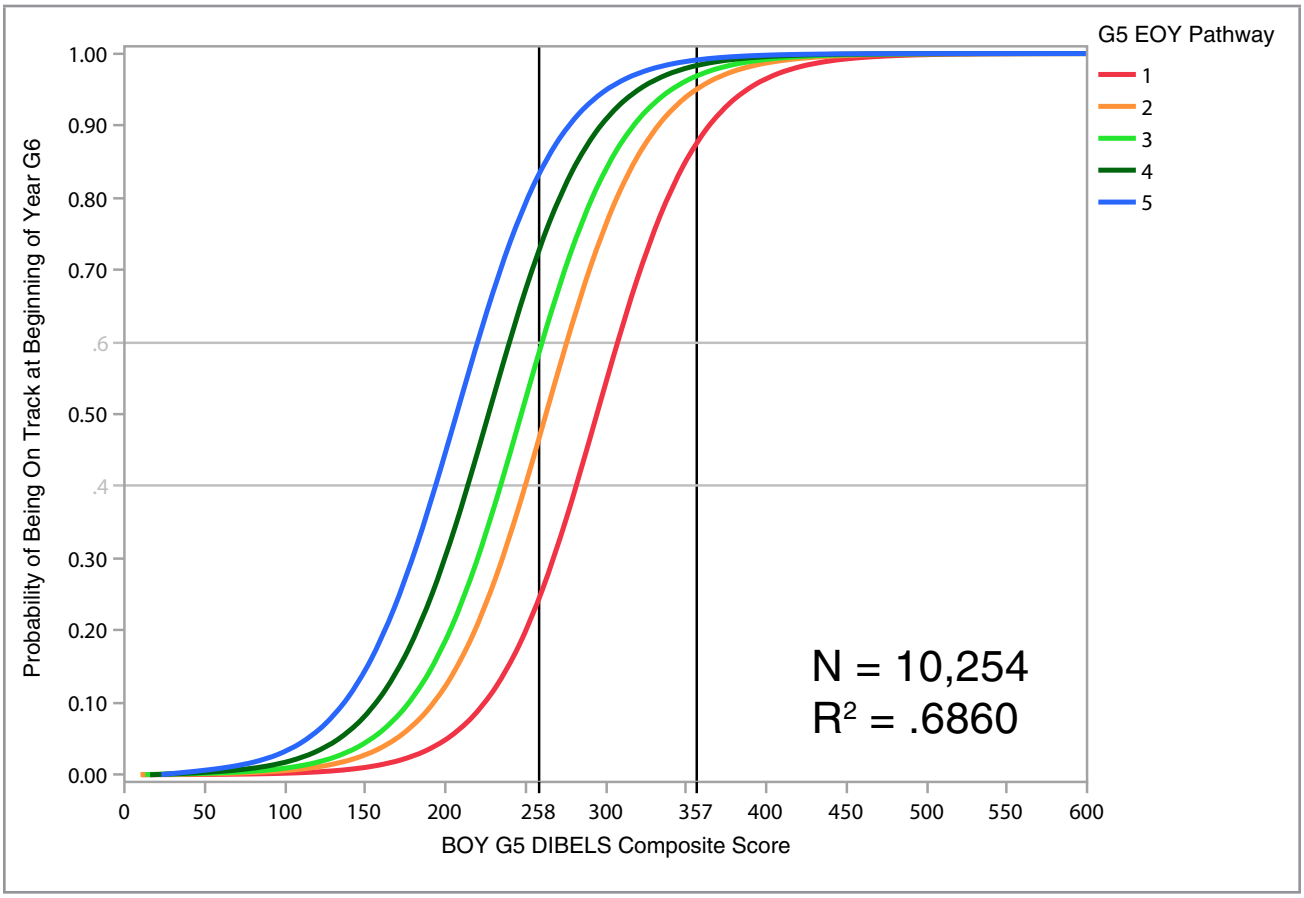

Table 1. Likelihood of Being At or Above Benchmark at Beginning of Next Grade Given Right At Benchmark at Beginning of Current Grade

Predictor	*Outcome*	*Path 1*	*Path 3*	*Path 5*
Grade K BOY	Grade 1 BOY	17%	57%	92%
Grade K BOY	Grade 1 EOY	35%	66%	91%
Grade 1 BOY	Grade 2 BOY	18%	88%	>99%
Grade 2 BOY	Grade 3 BOY	16%	48%	82%
Grade 3 BOY	Grade 4 BOY	18%	50%	81%
Grade 4 BOY	Grade 5 BOY	18%	46%	75%
Grade 5 BOY	Grade 6 BOY	88%	97%	99%

Table 2. Likelihood of Being At or Above Benchmark at Beginning of Next Grade Given Right At Cut Point for Risk at Beginning of Current Grade

Predictor	*Outcome*	*Path 1*	*Path 3*	*Path 5*
Grade K BOY	Grade 1 BOY	8%	39%	85%
Grade K BOY	Grade 1 EOY	21%	46%	82%
Grade 1 BOY	Grade 2 BOY	7%	68%	98%
Grade 2 BOY	Grade 3 BOY	5%	19%	61%
Grade 3 BOY	Grade 4 BOY	5%	19%	57%
Grade 4 BOY	Grade 5 BOY	5%	17%	48%
Grade 5 BOY	Grade 6 BOY	24%	58%	83%

Table 3. Variance Explained in Reading Outcomes

Predictor	*Outcome*	*Model R^2*	*Additional Variance Explained by Pathways of Progress™*
Grade K BOY	Grade 1 BOY	49%	25%
Grade K BOY	Grade 1 EOY	39%	15%
Grade 1 BOY	Grade 2 BOY	68%	35%
Grade 2 BOY	Grade 3 BOY	69%	7%
Grade 3 BOY	Grade 4 BOY	73%	5%
Grade 4 BOY	Grade 5 BOY	72%	5%
Grade 5 BOY	Grade 6 BOY	69%	5%

Note: Model R^2 is the Nagelkerke R^2 reported from a regression model predicting the Outcome from the DIBELS Next® Composite Score and the Pathway, plus any interaction between the Pathway and the DCS.

For grades K–4, the likelihood of being at or above benchmark at the beginning of the next grade, given a current-grade beginning-of-year DIBELS Next Composite Score right at the benchmark ranged from 16% to 18% for students on Pathway 1 (median = 18%); ranged from 45% to 88% for students on Pathway 3 (median = 57%); and ranged from 75% to >99% (median = 82%) for students on Pathway 5 (see *Tables 1* and *2*).

In contrast, for grades K–4, the likelihood of being at or above benchmark at the beginning of the next grade, given a current grade beginning-of-year DIBELS Next Composite Score right at the cut point for risk ranged from 5% to 8% for students on Pathway 1 (median = 5%); ranged from 17% to 68% for students on Pathway 3 (median = 19%); and ranged from 48% to 98% (median = 61%) for students on Pathway 5 (see *Tables 1* and *2*).

The results differed for grade 5; all probabilities were higher than in grades K–4. For students right at benchmark, the likelihood of being at or above benchmark at the beginning of sixth grade was 88%, 97%, and 99% for students in pathways 1, 3, and 5, respectively. For grade 5 students at the cut point for risk, the likelihood of being above benchmark at the beginning of sixth grade was 24%, 58%, and 83%, for pathways 1, 3, and 5, respectively. Finally, the amount of variance by beginning-of-year initial skills and end of year Pathway on subsequent grade level outcomes is substantial (39%–73%) (see *Table 3*).

At every grade level, students who began the year with a DIBELS Next Composite Score at the cut point for risk and made well below typical progress across the year (Pathway 1) were very unlikely to score at the DIBELS Next Composite Score benchmark goal at the beginning of the following grade. However, if these same students were on Pathway 5 (e.g., well above typical progress), then they were quite likely to reach the goal (48%–98%). These data clearly indicate that a higher Pathway (greater progress) results in better future outcomes. This finding is particularly important when considering what occurs with students who are at the cut point for risk.

For example, the likelihood of a student reaching the benchmark at the beginning of fourth grade if that student begins third grade right at the benchmark and was on Pathway 1 at the end of third grade (i.e., well below typical progress) is about 18%. However, if

this same student were on Pathway 5 at the end of third grade, the likelihood of being at benchmark at the beginning of fourth grade is 81%. These differences in outcome are quite large.

Additional Variance Explained by Pathways of Progress

For the grade K–1 cohort and the grade 1–2 cohort, Pathways of Progress added 24% to 35% additional variance to reading outcomes over and above initial reading skills (see *Table 3*). For older grade cohorts, Pathways of Progress added 5% to 7% additional variance to reading outcomes (see *Table 3*).

Discussion

Summary and Conclusion

Prior research has found dramatic improvement in reliability for Pathways of Progress when compared to using slope of progress (see Good & Powell-Smith, 2015 & Good et. al. 2015). The current study expands this line of research with evidence of the predictive validity of Pathways of Progress for reading skills in the subsequent academic year. At most grade levels, if a student begins the year at the cut-point (or lower) and makes well below typical progress (Pathway 1), the likelihood of achieving subsequent grade level outcomes is extremely low (median = 7%). However, if a student begins the year at the cut-point (or lower) and makes well-above typical progress (Pathway 5), the likelihood of achieving outcomes in the subsequent grade level is quite high (median = 83%). Further, Pathways of Progress explains a considerable amount of additional variance beyond beginning-of-year performance. These results clearly show the strong predictive validity of Pathways for subsequent grade outcomes.

Limitations

The analysis in this study was conducted on actual student data from more than a thousand schools across the US. These schools represent a range of student skill, curricula, and instructional support. As such, our results are not the product from controlled settings. We have no measure of fidelity of assessment and we do not know the level of training of assessors. However, these data do represent the way DIBELS Next is used in practice. In addition, we do not know the level of instructional support provided to the students, or if there were changes in the level of support.

Implications for Practice

Know where students start. At most grade levels, if a student begins the year at the cut-point (or lower) and does not make progress (e.g., Pathway 1), the likelihood of achieving subsequent grade level outcomes is extremely low.

Set ambitious goals. One practical implication drawn from the results of this study speaks to the importance of setting ambitious goals, in particular for students who score in the well-below and below benchmark range at the beginning of the year. One way to ensure goals are set that result in progress that increases the probability a student will be at or above benchmark in the future (a year later) is to use the Pathways of Progress goal setting utility[1]. The goal setting utility provides educators with the means to select goals that will reflect a specific Pathway based upon the student's initial skills. Using this utility, educators can determine and select goals for any of the DIBELS Next component measures and the DIBELS Next Composite that reflect Typical, Above Typical, or Well Above Typical progress. Similarly, educators can also see what end-of-year scores represent Below Typical and Well Below Typical progress.

Monitor student progress. As frequent student progress data are collected, educators can determine a student's Pathway by examining the data on their progress monitoring graph. For students not being monitored more frequently than benchmark assessment, both middle- and end-of-year classroom Pathways Reports are available. These reports provide educators with information about the Pathways for each DIBELS Next component measure and the DIBELS Next Composite for each student in a classroom.

Implications for Practice

This study provides one of the very few examinations of the impact of benchmark level performance in one grade on benchmark performance in the subsequent grade. In addition, this study is the only examination that we know of that uses the DIBELS Next Composite Score with a very large sample (N ≈ 1.8 million students) and accounts for progress across the year. Future research should replicate these results. Additionally, future research might examine these results for subgroups of students.

[1]The Pathways of Progress Goal-Setting Utility is available in DIBELSnet or through Amplify for mCLASS users. For additional information about Pathways of Progress see https://dibels.org/pathways_of_progress.html

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