Linking Climate Survey Results and Academic Achievement

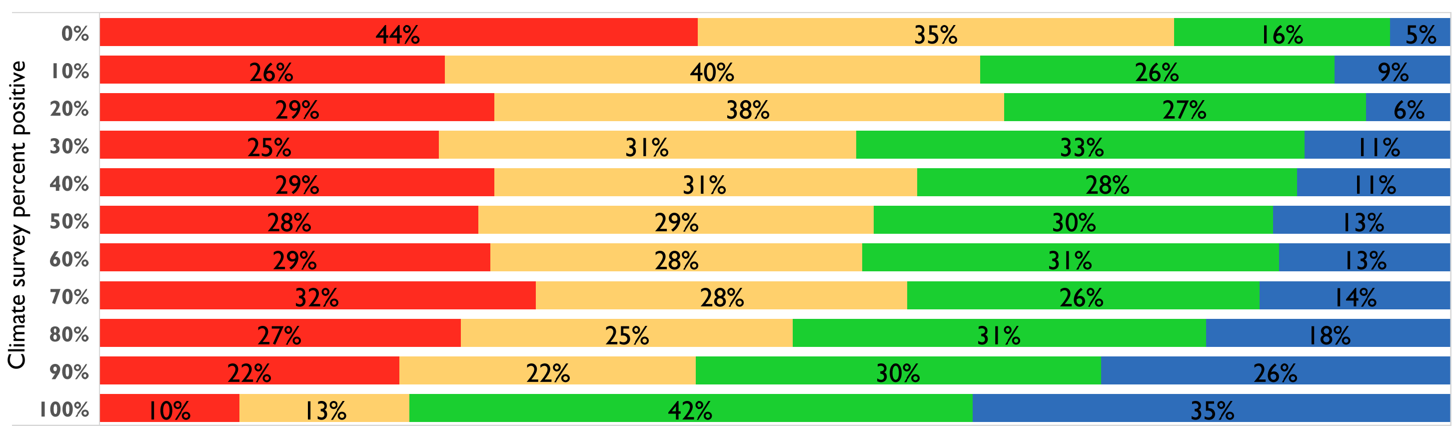
Key Findings

1. Students with more positive perceptions of climate are more likely to improve their MAP scores in reading and math, as well as more likely to acquire MAP math proficiency, at both the elementary and middle levels, holding demographics, school, elementary homeroom, and prior MAP scores constant.
2. High school students with more positive perceptions of climate are likely to have higher GPAs and fewer course failures, holding demographics, school, and prior GPA/course failures constant.
3. These findings suggest that positive school climate is important not just on its own, but as a way to promote growth in academic achievement.

Background

The Madison Metropolitan School District's Strategic Framework outlines three major goals for students. The first focuses on academic achievement, the second focuses on a challenging and well-rounded education, and the third focuses on positive climate. Each year, the district administers a climate survey to students, parents, and staff, that is our primary source for data for measuring our success on Goal #3. Although a positive climate is a desirable goal in and of itself, we wanted to examine whether a positive climate appears to impact performance on Goal #1 measures of academic achievement as well.

It is easy to illustrate an association between better climate perceptions and better academic outcomes. The graph below shows students' Spring 2016 MAP Reading Results disaggregated by how positive their climate survey responses were (red=minimal, yellow=basic, green=proficient, blue=advanced).



However, we cannot tell from a visual like this whether climate perceptions have any influence on achievement, or if it just happens that students who perform better also feel better about their educational experience. Therefore, we want to use advanced methods to explore whether experiencing a more positive climate appears to lead to improvements in academic performance.

Methods

Our primary concern is whether students who perceive better school climate are more likely to improve on key academic variables from one year to the next. The outcome variables we chose are used by schools to set goals on an annual basis within their School Improvement Plans (SIPs). These SIP measures are connected to Strategic Framework Milestones for Goal #1, our major metrics for tracking the district's progress over time, and are predictive of on-time high school completion.

Therefore, we conduct a series of regression models to predict these outcomes, using individual student perceptions of climate as our independent variable of interest, as well as a robust set of controls for demographic characteristics and prior academic performance. Although we do not claim that these models are causal, we believe they are promising for showing associations between climate perceptions and outcomes.

The timeline above shows the timing of our prior year (control) metrics, the climate survey, and our current year (outcome) metrics. Based on this timing, we believe it is appropriate to measure a potential effect of perceived climate on current year outcomes.

We created our independent variable of interest based on each student's responses to closed-ended Likert-style questions on the district's climate survey. Each question had five possible responses – one very negative, one negative, one neutral, one positive, and one very positive. For each student, we calculated their percent of responses that were either positive or very positive. So, for example, a student with positive or very positive responses to 80% of questions would have a value of 0.80 for that variable.

For our models, we employ a technique known as Hierarchical Linear Modeling (HLM). HLM is designed to deal with clustering within datasets. In our case, we want to use HLM because schools with better climate might have better academic growth, and homeroom teachers with better climate also might have better student academic growth. Without accounting for this, we might assume that improving a student's perceptions of climate would enhance their growth, but in reality, we would just be observing that some schools or homerooms improve both climate and academic growth, meaning that one does not necessarily affect the other. With our mixed effects models, we can effectively filter out school effects and homeroom effects to estimate more precisely whether changes in individual student perceptions lead to changes in academic outcomes, regardless of their school or homeroom. For our elementary school models, we account for both school and homeroom; for our middle and high school models, we account for schools only because of the lack of a homeroom teacher responsible for the majority of each student's academic instruction. Detailed information about the variables included in each model is available in the Appendix.

Findings

Elementary

The results of the HLM models for elementary students appear below. For each model, we present the coefficient only for percent positive climate survey responses (our independent variable of interest); the full regression models are available upon request.

	RIT Score		Proficiency Odds	
	Reading	Math	Reading	Math
Climate survey percent positive	**2.66*****	**2.11*****	1.57	**2.91*****

Note: Statistically significant coefficients appear in **bold.** *=p<0.10, **=p<0.05, ***=p<0.01. Proficiency regression coefficients are odds ratios.

These results show that when controlling for demographics, prior MAP performance, school effects, and homeroom effects, students with higher perceptions of climate are expected to have higher MAP score gains from one year to the next in both reading and math, and are more likely to achieve proficiency in math.

Each coefficient for RIT scores is associated with a 100% movement in positive responses; for example, in effect, the model says that holding demographics, prior performance, school, and homeroom constant, a student with 100% positive responses would have a reading RIT score gain that is 2.66 points higher on average than a student with 0% positive responses. We acknowledge that a move from 0% to 100% positive responses is quite large, and a corresponding RIT score gain of 2.66 points does not appear particularly large. However, it is worth considering that typical MAP growth targets from fall to spring, which are based on 26 weeks of instruction, usually are in the single digits, with a majority falling between 3 and 6 points in reading.

The coefficients for proficiency represent odds ratios, which represent the changes in likelihood of an outcome based on changes in a predictor. An odds ratio greater than one means that the outcome is more likely as the predictor increases. In our case, they illustrate the change in likelihood of attaining proficiency associated with higher climate survey results. Note that in this case, odds are not the same as probability; if a student with 100% positive climate results was 50% likely to be proficient in MAP Reading, their proficiency odds would be 1:1, or about 1.0. If a student with 0% positive climate results was 26% likely to be proficient in reading, their proficiency odds would be 26:74, or about 0.35. Therefore, the odds ratio associated with 100% positive climate results would be 1.0/0.35, or about 2.86. Therefore, odds ratios have a tendency to magnify differences in probability.

We observe that a student with 100% positive climate results would have odds of math proficiency 2.91 times higher than those of a student with 0% positive climate results, holding demographics, school, homeroom, and prior proficiency constant. Although the odds ratio associated with reading proficiency is above 1, it is not statistically significant.

Middle

The results of the HLM models for middle school students appear below. Again, we present the coefficient only for percent positive climate survey responses (our independent variable of interest); the full regression models are available in the appendix, although the coefficients for the control variables included should not be interpreted.

	RIT Score		Proficiency Odds	
	Reading	Math	Reading	Math
Climate survey percent positive	**0.75*** **	**0.89*** **	**2.43*** **	**2.89*** **

Note: Statistically significant coefficients appear in **bold.** *=p<0.10, **=p<0.05, ***=p<0.01. Proficiency regression coefficients are odds ratios.

These results show that when controlling for demographics, prior MAP performance, and school effects, students with higher perceptions of climate are expected to have higher MAP score gains from one year to the next in both reading and math. These effects are much smaller than those observed at the elementary school level and correspond to less than one RIT score point on average. Numeric gain in RIT scores typically is lower at the middle school level than the elementary level, but we concede that these effects, although statistically significant, are not large in practical terms.

We also observe that students with higher climate scores are significantly more likely to achieve proficiency in MAP Spring Reading and Math.

High

The results of the HLM models for high school students appear below. As with elementary and middle school, we present the coefficient only for percent positive climate survey responses (our independent variable of interest); the full regression models are available in the appendix, although the coefficients for the control variables included should not be interpreted.

	Annual GPA	Number of Annual Course Failures
Climate survey percent positive	**0.20*** **	**-0.94*** **

Note: Statistically significant coefficients appear in **bold.** *=p<0.10, **=p<0.05, ***=p<0.01.

These results show that students experiencing better climate had higher GPAs and fewer course failures, even when controlling for demographics, school, prior year GPA (for the GPA model), and prior year failures (for the failures model).

As we mentioned earlier, each coefficient for RIT scores is associated with a 100% difference in positive responses. Therefore, this data shows that a student with all positive climate responses would be expected to have an annual GPA about 0.2 points higher than a student with no positive climate responses, holding demographics, school, and prior year GPA constant. Similarly, a student with all positive climate responses would have almost one fewer course failure than a student with no positive climate responses, holding demographics, school, and prior year failures constant.

Conclusion

Through our analysis, we have demonstrated that students who experience a more positive school climate, as measured by MMSD Climate Survey results, are likely to have better results than students who experience a less positive school climate on academic outcomes related to Strategic Framework Goal #1. Better perceptions of climate appear to drive MAP RIT score improvement across levels and subjects, MAP proficiency attainment in select levels and subjects, higher GPA, and fewer course failures.

These results point to both the utility of our Strategic Framework Milestones for school climate, as well as the importance of students' perceptions of climate not just in and of themselves, but as a way to drive academic outcomes. If we can improve perceptions of school climate, we will likely see improvements in academic measures. Our previous research has already demonstrated the predictive power of many of our key academic achievement Strategic Framework Milestones on on-time graduation and postsecondary enrollment. Therefore, it stands to reason that if moving climate moves achievement outcomes, then moving climate also will move on-time graduation and postsecondary enrollment. This trend is especially important for historically underperforming groups, for whom we want to accelerate achievement. If we can improve perceptions of climate for those groups, we will likely see their academic measures rise and hopefully achieve more equitable outcomes for all students.

Appendix: Regression Model Components

Level	Outcome	Model	Controls
Elementary (Grades 3-5)	Spring MAP Reading RIT score	Multilevel mixed effects linear regression (Stata: xtmixed)	Prior spring RIT score; demographics; random effects by school; random effects by homeroom
Elementary (Grades 3-5)	Spring MAP Math RIT score	Multilevel mixed effects linear regression (Stata: xtmixed)	Prior spring RIT score; demographics; random effects by school; random effects by homeroom
Elementary (Grades 3-5)	Spring MAP Reading proficiency	Multilevel mixed effects logistic regression (Stata: xtmelogit)	Prior spring proficiency; demographics; random effects by school; random effects by homeroom
Elementary (Grades 3-5)	Spring MAP Math proficiency	Multilevel mixed effects logistic regression (Stata: xtmelogit)	Prior spring proficiency; demographics; random effects by school; random effects by homeroom
Middle (Grades 6-8)	Spring MAP Reading RIT score	Multilevel mixed effects linear regression (Stata: xtmixed)	Prior spring RIT score; demographics; random effects by school
Middle (Grades 6-8)	Spring MAP Math RIT score	Multilevel mixed effects linear regression (Stata: xtmixed)	Prior spring RIT score; demographics; random effects by school
Middle (Grades 6-8)	Spring MAP Reading proficiency	Multilevel mixed effects logistic regression (Stata: xtmelogit)	Prior spring proficiency; demographics; random effects by school
Middle (Grades 6-8)	Spring MAP Math proficiency	Multilevel mixed effects logistic regression (Stata: xtmelogit)	Prior spring proficiency; demographics; random effects by school
High (Grades 10-12)	Annual GPA	Multilevel mixed effects linear regression (Stata: xtmixed)	Prior year GPA; demographics; random effects by school
High (Grades 10-12)	Annual course failures	Multilevel mixed effects linear regression (Stata: xtmixed)	Prior year failures; demographics; random effects by school