Do Classroom Environments Matter for Noncognitive Aspects of Student Performance and Students' Course Grades?[1]

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Recent years have seen a backlash against the prevalence of standardized tests in K-12 schools, coinciding with a growing appreciation for the many "noncognitive" factors[2] that matter for young people's school and life success, but that are not measured by cognitive tests.[3] Interest in noncognitive factors has been buttressed by a mounting body of evidence showing that motivation, interest, effort, perseverance, attitude, and belief, play an integral role in shaping people's educational and life outcomes and that these all develop alongside academic learning. Further, research shows that students' course grades are more reflective of these noncognitive factors than are test scores.[4]

The idea that course grades reflect noncognitive aspects of students over and above their cognitive skills and academic content knowledge is consistent with a growing body of empirical evidence. Despite the often myopic focus on standardized tests in K-12 education, researchers repeatedly have found GPA to be a much stronger predictor than test scores of later outcomes (e.g., high school graduation, college enrollment, college graduation, and workforce success).[5] In Chicago, while both GPA and test scores measured cognitive ability in Chicago Public Schools students, GPA contributed uniquely to the

[1] This research was generously funded by the Raikes Foundation, the Bill and Melinda Gates Foundation, and the William and Flora Hewlett Foundation.

[2] The word "noncognitive" is used simply to refer to all the qualities or other student variables that are not measured by tests of intelligence or cognitive achievement. The authors use the word only so narrowly defined. In other work (e.g., Nagaoka et al., 2015), we have argued vociferously that the cognitive dimensions of human learning and life are inseparable from the social, emotional, and behavioral dimensions. In other words, while we recognize its analytic utility, from a human development and learning perspective, we reiterate that there is no such thing as noncognitive.

[3] Heckman & Rubinstein (2001).

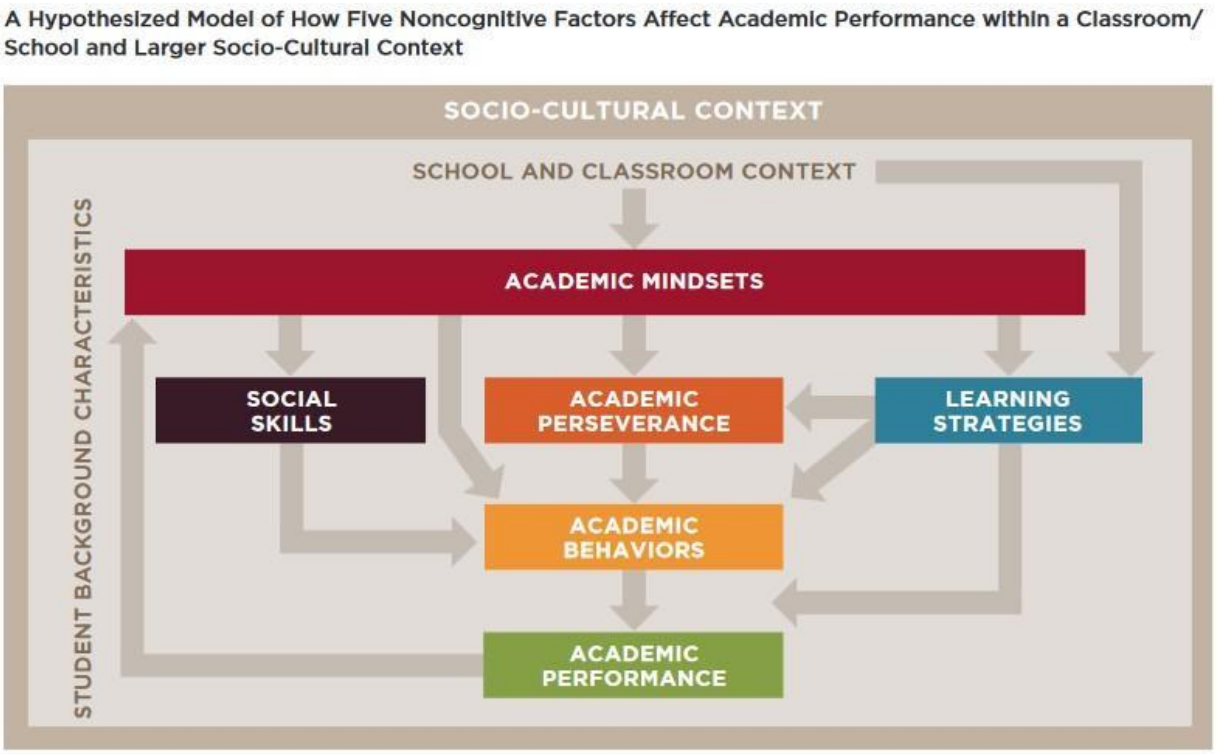
[4] Borghans & Schils (2012); Farrington et al. (2012); Jackson (2012).

[5] Bowen, Chingos, & McPherson (2009); Easton, Johnson, & Sartain (2017); Geiser & Santelices (2007); Hoffman & Lowitzki (2005).

prediction of important outcomes, even after accounting for test scores. Further, incremental increases in GPA showed bigger payoffs in college completion than did incremental increases in test scores.[6] This growing body of evidence raises questions about the role of teachers and classrooms in fostering the development of important noncognitive factors in students—and in potentially improving their course performance as well as their longer-term educational outcomes in the process.

To begin addressing these questions, in 2012 UChicago Consortium researchers reviewed the available literature across five categories of noncognitive factors (academic behaviors, academic perseverance, academic mindsets, learning strategies, and social skills) to identify their relationships with course grades for students ages 10-20.[7] Drawing from a broad range of empirical evidence, we created a hypothesized model of how these noncognitive factors interact to produce academic performance (see Figure 1).

Figure 1. Hypothesized Model (Farrington et al., 2012)



In developing this model, we were particularly interested in the role of teachers and classrooms in fostering students' noncognitive factors. Drawing from extant research, we hypothesized that teachers' instructional practices and the conditions for learning that they create inside the classroom would *directly* influence students' academic mindsets and learning strategies—in other words, the *why* and the *how* of student

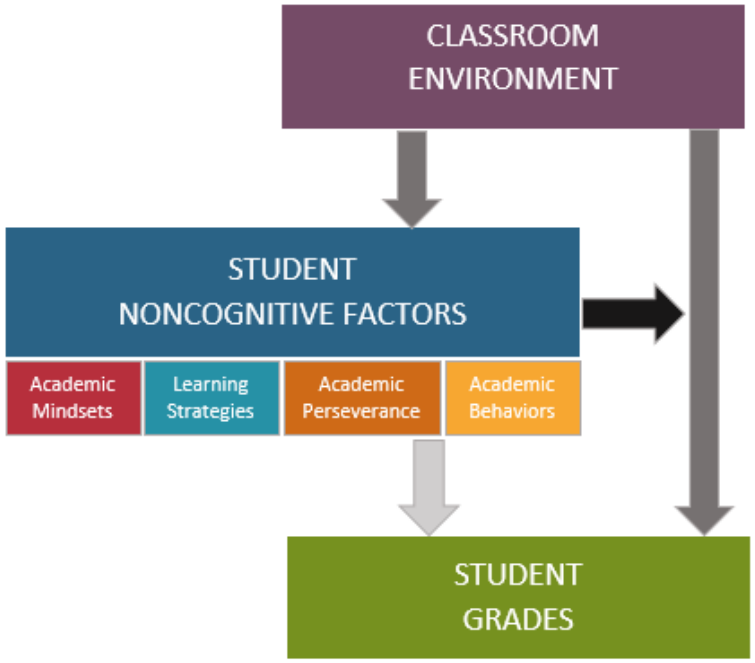
[6] Allensworth & Easton (2005, 2007); Roderick, Nagaoka, & Allensworth (2006).
[7] Farrington et al. (2012).

engagement in learning—and *indirectly* influence downstream outcomes of academic perseverance, academic behaviors, and grades.

Investigating the Role of Classroom Environments in Student Development and Academic Achievement

In the present study, we used student surveys and administrative data to empirically test the relationships among three components in our earlier model: classroom environments, selected student noncognitive factors, and students' course grades (see Figure 2). We focused on three research questions: 1) Are student noncognitive factors related to student grades? 2) Are classroom environments related to student noncognitive factors and to the grades students earn in their classes? and 3) Do student noncognitive factors mediate any existing relationship between classroom environment and student grades?

Figure 2. Hypothesized Relationships Tested in the Current Study



Are Student Noncognitive Factors Related to Student Grades?

We began with the relationship between four categories of student noncognitive factors and students' course grades: **academic mindsets** (i.e., student self-beliefs in an academic setting); **learning strategies** (i.e., the processes or tactics used to aid in the cognitive work of thinking, remembering, or learning); **academic behaviors** (e.g., attending class, studying, completing homework); and **academic**

perseverance (i.e., the duration, intensity, and quality with which students engage in academic behaviors, particularly in the face of difficulties or setbacks).

In prior correlational and experimental studies, positive academic mindsets (sense of belonging, self-efficacy, growth mindset, and relevance) were associated with higher levels of perseverance at academic tasks, better academic behaviors, and higher grades. Conversely, negative or maladaptive mindsets were associated with withdrawal of effort, particularly in the face of difficulty; worse academic behaviors; and lower grades.[8] Studies have also shown positive relationships between students' course grades and academic perseverance,[9] learning strategies,[10] and academic behaviors.[11] In the present study, we tested whether these four categories of noncognitive factors, as measured by self-report surveys in the context of specific classes, predicted students' end-of-semester course grades in those classes, collected from administrative data.

Are Classroom Environments Related to Student Noncognitive Factors?
Are Classroom Environments Related to Student Grades?

In addition to the relationship between student noncognitive factors and student grades, a second area of investigation we investigated was the relationships between classroom environments and two aspects of students: their self-reported noncognitive factors and their end-of-semester course grades. There is broad consensus and cross-disciplinary empirical evidence about the role of environments in shaping human learning and development.[12] Applying this to school environments, most existing research seeks to either understand how different school environments (e.g., climate and culture studies) or how specific programs implemented across schools (e.g., cross-site program evaluations) are related to students' learning and development. This line of investigation tacitly assumes that schools or programs, respectively, are the operative level of influence on student development.

Much less attention has been paid to students' experience across different classrooms within the school day, and the ways different classroom environments might elicit different behaviors from or foster different aspects of development within a student. We hypothesized that classrooms provide a rich set of opportunities that can shape students' social, emotional, and intellectual development through the relationships, social interactions, and experiences they offer,[13] that classroom environments may vary significantly from one another in the developmental opportunities they offer, and that these settings are worthy of study.

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[8] Aronson, Fried, & Good (2002); Blackwell, Trzesniewski, & Dweck (2007); Cohen & Garcia (2008); Hulleman & Harackiewicz (2009); Osterman (2000); Ryan & Deci (2000); Yeager & Walton (2011).
[9] Duckworth, Peterson, Matthews, & Kelly (2007); Duckworth & Seligman (2005).
[10] Dignath, BüttnerButtner, & Langfeldt (2008); Pintrich & DeGroot (1990); Purdie & Hattie (1996); Zimmerman & Martinez-Pons (1986).
[11] Allensworth & Easton (2007); Cooper, Robinson, & Patall (2006); Keith (1982). See Farrington et al. (2012) and Rosen, Glennie, Dalton, Lennon, & Bozick (2010) for a more thorough review of the evidence of the relationship between noncognitive factors and academic performance.
[12] Cantor Osher, Berg, Steyer, & Rose (2018); Jones & Kahn (2017); National Academies of Sciences, Engineering, and Medicine (2018); Osher, Cantor, Berg, Steyer, & Rose (2018).
[13] Nagaoka et al. (2015).

A basic tenet of social science research is that people's behavior and performance is the result of an ongoing, interactive dance between person and context, shaped by how they interpret messages and events in their environment.[14] Young people receive a barrage of messages from the larger societal context about the expectations for their academic success on the basis of race/ethnicity, gender, socioeconomic status, language of origin, special education designation, prior academic performance, or other stigmatized social categories. Such messages, whether explicit or implicit, and the commonly shared group-based stereotypes that underlie them, have been shown to affect students' academic mindsets, perseverance, behaviors, and performance.[15] While teachers may have little or no direct influence on the larger societal context in which students are situated, research suggests that teachers, in fact, have considerable power in shaping the classroom contexts in which students learn in ways that matter for students' psychological experiences in school.[16] For example, by creating classrooms centered on relational trust, high academic expectations, and meaningful work, connected to students' interests and passions, teachers are able to have substantial influence on the meaning students make of their schooling experiences and the effort they put into learning.[17]

We were particularly interested in the extent to which teacher behaviors and instructional practices in the classroom shaped how students develop or exhibit a variety of noncognitive factors, and to what extent these aspects of classroom environment were related to students' academic performance, as measured by their course grades. We recognize that classroom environments may exert influence on students' noncognitive development and academic performance in ways that are both purposeful (i.e., the teacher intentionally works to develop noncognitive aspects of students) and inadvertent (i.e., teacher behaviors influence students' development or performance in either positive or negative ways independent of the teacher's awareness or intentions). In the present study, we did not have measures of teachers' intentions, but we were able to test whether students' perceptions of the classroom environment were systematically related to their own self-reported noncognitive factors. We tested the relationships between classroom environments and the same four categories of noncognitive factors referenced above: academic mindsets, learning strategies, academic behaviors, and academic perseverance. We also looked at the relationships between classroom environments and students' course grades (e.g., whether the classroom environment of a student's math class was related to that student's final semester grade in math).

Do Student Noncognitive Factors Mediate the Relationship between Classroom Environments and Student Grades?

Finally, if we saw a relationship between classroom environment and student grades, we were interested in understanding the extent to which that relationship might be mediated by student noncognitive factors. In other words, might classroom environments influence students' academic achievement by developing (or undermining the development of) students' mindsets, perseverance,

[14] Berger & Luckmann (1966); Weick (1995).
[15] Cheryan, Plaut, Davies, & Steele (2009); Murphy, Steele, & Gross (2007); Tenenbaum & Ruck (2007); Yeager et al. (2014).
[16] Ferguson (2003); Gershenson, Holt, & Papageorge (2016); Meyer & Turner (2002).
[17] Bryk & Schneider (2003): Farrington et al. (2012); Quay & Romero (2015).

learning strategies, or academic behaviors? These research questions guided the design and analysis of the study presented here.

METHODS

There is broad interest in tools to measure student mindsets, perseverance, learning strategies, and academic behaviors in real educational settings, though researchers have urged caution in the use of individual-level assessments, particularly for accountability purposes.[18] We argue elsewhere that, without tools that simultaneously measure these noncognitive factors and the contexts in which they are exhibited (or not), studies might reinforce the notion that noncognitive factors are entirely "characteristics of individuals—implying that the 'fix' is at the individual level" rather than interrogating the role of the school or classroom in which noncognitive factors are developed or cued.[19] To better understand how and under what conditions students develop into effective learners, we need much more sophisticated, multifaceted ways of understanding relationships among teacher practices and classroom processes; student beliefs, attitudes, and behaviors; and students' academic performance. The design of the present study sought to shed light on these phenomena.

Survey Design

An interdisciplinary team of University of Chicago Consortium on School Research (UChicago Consortium) researchers designed the *Becoming Effective Learners* Student Survey (BEL-S) to illuminate relationships among important student, classroom/instructional, and academic outcome variables. The team brought together expertise in psychometrics, social psychology, survey design, classroom instruction, and social work. We used Rasch measurement models to create a survey instrument that could more precisely measure both noncognitive constructs and students' perceptions of their classrooms. Survey items were developed for each construct of interest and then cognitively tested with middle school and high school students. Data from an initial pilot was Rasch analyzed and used to further refine the survey instrument.[20]

As noted above, a key question in the field has to do with the extent to which noncognitive factors are situated *within individuals* (as individual characteristics or traits that remain stable as students move across contexts) in contrast to being situated *in the interaction* between individuals and external conditions in the environment. To shed light on the question of how much noncognitive factors vary within individual students across classrooms, we need tools that can measure noncognitive factors *in specific contexts* as well as classroom conditions and instructional practices in those contexts.

The BEL-S was designed for this purpose. Students were asked to respond to a bank of questions on their own noncognitive factors, as well as their perceptions of teacher practices and learning environments in the context of a specified "target class," preselected from among their core academic

[18] Assessment Work Group (2019); Duckworth & Yeager (2015).
[19] Farrington et al. (2012).
[20] Farrington & Levenstein (2014).

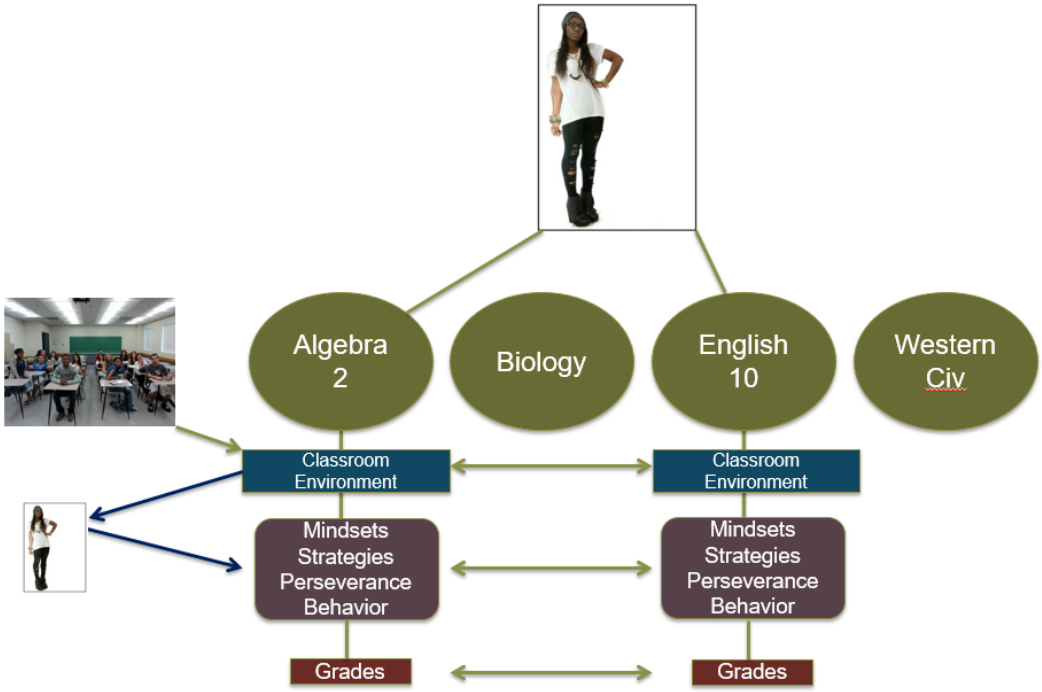
Table 1. BEL-S Survey Constructs and Sample Items (see Appendix for complete list of items)

Constructs	Sample items
Classroom Environment Omnibus measure includes: - Teacher Support - Goal clarity - Organization - Relevance - Classroom community - Coursework	How TRUE are the following about your [Algebra 2 class]? *Not at all true, A little true, Somewhat true, Mostly true, Completely true* This teacher notices if I have trouble learning something. This teacher connects what we are learning in class to real life. This teacher explains things in a different way if we don't understand it the first time. This teacher asks for our input about what we want to learn.
Mindsets - Belonging - Performance Avoidance* - Motivation	How TRUE is this in your [Algebra 2 class]: *Not at all true, A little true, Somewhat true, Mostly true, Completely true* I feel like my classmates accept me for who I am. [*Belonging*] I don't ask questions in this class because I don't want people to think I'm dumb. [*Performance Avoidance*] Overall, how motivated are you to work hard in your [Algebra 2 class]? *Not at all motivated, Only a little motivated, Somewhat motivated, Mostly motivated, Completely motivated*
Learning Strategies Omnibus measure includes: - Organization & Time Management - Self-monitoring	How TRUE is this in your [Algebra 2 class]: *Not at all true, A little true, Somewhat true, Mostly true, Completely true* I keep track of my assignments so I know when to turn them in.
Perseverance - Academic Delay of Gratification - Self-Regulation*	How well do these describe you in your [Algebra 2 class]: *Not at all like me, A little like me, Somewhat like me, Mostly like me, Completely like me* I finish all of my homework for this class <u>before</u> I do things for fun. [*Academic Delay of Gratification*] I stop trying in this class if I get discouraged. [*Self-Regulation*]
Academic Behaviors - Class Participation	In your [Algebra 2 class], how often do you turn in assignments on the due date? *Never, Once in a while, About half the time, Most of the time, Always*

classes (science, math, social studies, and language arts). In the second half of the survey, they were asked to respond to the entire bank of questions again in the context of a second specified target class. (See Table 1 for sample questions.) To achieve a robust sample of classroom data, target course selection for each student was determined by an algorithm using the full course schedule data from each school. The algorithm sought to maximize both the total number of classrooms on which we were collecting data and the number of students reporting on each of those classrooms. Selected target classes were then preprogrammed into the survey for each student.

Figure 3 illustrates how data were collected: each student reported on both the classroom environment and their own internal noncognitive factors (mindsets, learning strategies, perseverance, and academic behavior) for each of their two target classrooms. Classroom environment scores were calculated for each classroom by drawing on data from all the students reporting on that target class.

Figure 3. Survey Questions ask Students about Classroom Environment and their own Noncognitive Factors within two preselected Target Classes



This study design offered a particularly important advantage in investigating the role of classrooms in student development, permitting us to make within-student comparisons of student noncognitive factors across two of their classrooms. In other words, we were able to see if students' self-reports of mindsets, perseverance, strategy use, and/or behaviors varied from one target class to the next, and the extent to which differences in the classroom environments in those two target classes predicted any such differences in student noncognitive factors. In most survey research, respondents are compared to

one another, controlling for known differences and similarities among them (e.g., race, gender, prior achievement). A significant limitation of such research is the inability to rule out the influence of unobserved variables that might differentiate respondents and skew results. In the present study, it would be hard to attribute differences in outcomes to differences in classrooms if we also had different students in each place. Because we had survey data from two classrooms for each student, we only compared students to themselves as we try to detect the influence of classroom environments on noncognitive factors and course grades.

Finally, we also received students' end of semester course grades from administrative data, allowing us to test whether self-reported differences in noncognitive factors or in students' perceptions of classroom environments were associated with differences in their final course grades.

Data

In fall 2014, we recruited a convenience sample of charter schools and traditional district schools to participate in the first large-scale pilot of the BEL-S. The sample included 8,318 students across 25 schools: Seven public neighborhood schools in Chicago and 18 charter schools across six states (CA, CO, IL, MI, NY, TX). The 18 charter schools accounted for the majority of the data collected (84 percent of students) in our analytic sample. In addition to BEL-S survey data, we also obtained administrative records for participating students that included course schedules, demographic variables (race/ethnicity, gender, age, grade level, free-/reduced-price lunch eligibility, special education status, and English Learner designation). In addition to using these administrative data to categorize students, we also used course schedules and student demographic data to construct classroom composition variables for each classroom. At the end of the semester in which the surveys were administered, we also received official semester course grade data.

Measures

Predictors: Classroom Environment. We used Rasch analysis to create a measure from students' reports of each target classroom environment. Classroom environment captured six dimensions of classrooms: how well **organized** a teacher's classroom was; how much academic **support** a teacher gave students; how much the teacher fostered a sense of **community** in the classroom; how clearly a teacher articulated **learning goals**; how engaging and challenging the **work** assigned by the teacher was; and how much the teacher made the course content **relevant** to students' lives. Confirmatory factor analysis suggested that all classroom environment measures loaded onto a single scale. Items were selected for this omnibus (single scale) classroom environment measure from the six classroom dimensions, based on the strength of their relationship with student course grades in the pilot validation study. Items and response scales for this omnibus Classroom Environment measure are included in the Appendix.

Using this omnibus measure, we calculated an aggregate *Classroom Environment* score for each classroom and used this to predict individual students' self-reported noncognitive factors and student grades, as illustrated in Figure 3. To ensure that this was an unbiased contextual effect (i.e., to eliminate the influence of a student's own report of that classroom), instead of calculating a mean for the entire classroom, as is often done, we calculated a classroom environment "other-student-mean" for each

student, representing the mean of all of the other student reports in the classroom, omitting the student's own report. We used these "other-student-mean" classroom environment scores to predict individual students' noncognitive factors and student course grades for each target class.

Predictors: Noncognitive Factors. In this study, we focused on four categories of noncognitive factors from our model—academic mindsets, learning strategies, perseverance, and academic behaviors—measured by self-report from each student in each of two target classrooms. Items and response scales for all noncognitive measures are included in the Appendix. "Academic mindsets" included two Rasch measures: *Belonging,* a belief that one is part of a shared academic community in the classroom; and *Performance Avoidance,* a concern about appearing incompetent or unintelligent that causes students to withdraw from participating in class. Academic mindsets also included *Motivation*, a single-item self-report of how motivated one is to do well in class.

"Learning strategies" measures used Rasch measurement to capture students' organization (e.g. managing time to get all work done) and self-monitoring (e.g. checking whether or not one is understanding the material they are studying). For this analysis, the two measures were combined into one omnibus learning strategies measure score.

"Perseverance" included two measures: *Academic delay of Gratification* and *Self-regulation. Academic delay of gratification* was a Rasch measure of willingness to ignore desirable but distracting thoughts and activities in the service of completing academic work. *Self-regulation* was a Rasch measure of focused cognitive and behavioral efforts toward academic goals.

The sole measure of "academic behavior" was *Class Participation,* captured by a Rasch measure of how much students reported preparing for and participating in class.

Dependent Variable: Student Grades. Schools provided us with students' official course-specific end-of semester grades. We standardized grades separately for middle-school and high-school students.

Predictors: Control Variables. We controlled for a number of variables at the student and classroom levels. At the student level, student's *grade level* was a continuous variable, ranging from 6 to 12. In this version of the survey, we asked about several student noncognitive variables (*academic identity, grit*, *school belonging*, and *growth mindset*) in the context of school as a whole rather than in relation to specific target classes. We hypothesized that these were likely to be more "global" mindsets which would be descriptive of students' academic endeavors in general rather than their response to a particular classroom.[21] We used these global mindsets as student-level controls. Student *gender* and *race* were measured with a series of indicator variables. When comparing classrooms to one another, we controlled for the *gender* and *racial composition* of target classrooms. *Course subject* included a series of indicator variables for science, math, English, and social studies classes. In addition, we also controlled for the *classroom average* levels of *academic identity, grit, school belonging,* and *growth*

[21] In later versions of the BEL-S, we moved *academic identity, grit, and growth mindset* to the target class-level, to test our assumptions about their stability across classrooms.

mindsets. Finally, we used a school-fixed effects specification by controlling for indicators for each school in the data.

Analysis

This study sought to understand the extent to which students' experiences with different teachers—in different classrooms with different groups of peers—were related to their self-perceptions (self-reported mindsets, learning strategies, perseverance, and behaviors) and academic performance (as measured by final course grades). Within-student estimates are akin to "student-fixed effects" models; we used the information we had to control for each student. We did this by student-centering all predictors that vary within students: classroom environments, noncognitive factors, and the classroom composition and classroom average variables. (We did not student-center class subject, because virtually all variation in class subjects was within-student.) For example, if a hypothetical student's score for learning strategies in her English class was 0.10, and her score for learning strategies in her math class was -0.60, her mean learning strategies score for her two observations would be -0.25 (0.10 minus 0.60 = -0.50 divided by 2 = -0.25). Centering her learning strategies on her mean would result in a score of 0.35 for her English class (0.10 minus -0.25 = 0.35) and -0.35 for her math class (-0.60 minus -0.25 = -0.35). Student-centering predictors effectively strips any between-student variation in them.

Because we have a cross-nested design, with observations nested in students, who are members of multiple classrooms, we used a multilevel model. The equation for the cell level is as follows: $Y_{ijk}=\pi_{0jk}+\Sigma\,\pi_{pijk}\,(a_p)+e_{ijk}$

Y, the outcome, is observed for observation *i* nested in student *j* and classroom *k.* It is a function of an intercept that varies among students and classrooms (π_{0jk}), observation-level predictors (a_{pijk}) and a random error term e_{ijk}.

At the between-cell level, our equation is:

$$\pi_{0jk}=\theta_{00}+\Sigma\,\gamma_{0q}X_{qj}+\Sigma\,\beta_{0q}(W_{qk})+c_{0j}+b_{0k}$$

The random intercept π_{0jk} is a function of a constant $\theta_{00,}$ student-level predictors ($X_{qj,}$ which is a vector of q student gender, race, global mindsets, and school indicator variables), course-level predictors ($W_{qk,}$ which is a vector of q course subject indicators), and student- and classroom-level random effects (c_{0j} and $b_{0k,}$ respectively).

RESULTS

Before we turn to our research findings, we need to examine sources of variation in our key variables. Since we had students embedded in classes and in schools, we want to determine how much variability these sources contribute to students' survey responses as well as to their course grades. This provides one way of understanding the extent to which student noncognitive variables are stable within students, regardless of context or the extent to which they vary from one environment to another.

Do Student Noncognitive Factors Vary from One Context to the Next?

Since we observed different students—and observed each student in two different classes—variation in students' grades, students' perceptions of class environments, and student noncognitive factors can lie between and within schools, classrooms, and students. To get a sense of how important these different sources of variation were, we ran empty multilevel models. (These models also included an intercept that varies randomly across schools in addition to varying across students and classrooms.) After accounting for these sources of variation, the only residual variability (beyond measurement error) would be that associated with the combination of particular students and classrooms, which we interpreted as the unique *interaction* between student and classroom. For example, Ms. Moore's math class might have a particular kind of effect on students in general, and Jocelyn might be a particular kind of student, regardless of which class she is in, but there is a unique interaction between Ms. Moore's math class and Jocelyn as a student that isn't explained either by Ms. Moore's typical effect on students or Jocelyn's typical way of being in a classroom.

The results of this variance portioning exercise are presented in Table 2, showing that only a small portion of the variation in student grades, students' perceptions of their classroom environments, or students' self-reported noncognitive factors could be attributed to classrooms or schools. At most, for example, classrooms and schools combined explained about 20 percent of the variation in students' semester grades. Classrooms themselves only explained about 15 percent of the variation in students' perceptions of their classroom environments. Across almost all variables, the strongest source of variation was the student. Over half of the variation in students' perceptions of classroom environments and self-reported noncognitive factors (except for motivation) lay between students.

However, the interaction between students and classrooms (the residual variation) accounted for a substantial portion of the variation in course grades, student perceptions of their classroom environments, and self-reported noncognitive factors, ranging from 0.19 (in the case of learning strategies) to almost 0.50 (in the case of motivation). So, while a large percentage of the variation in students' noncognitive factors was explained by differences between students, an almost equally large percentage of the variation was explained by unique interactions between individual students and particular classrooms (as in the illustrative example of Jocelyn in Ms. Moore's math class). One way to interpret this is that classrooms, in fact, do seem to matter for students' noncognitive development; they just matter differently for different students. Noncognitive factors seem to be malleable when measured from one context to another, but in ways that are apparently quite nuanced.

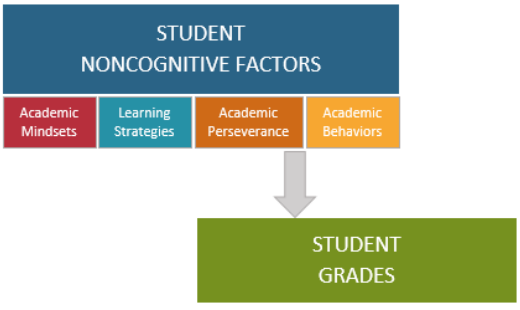
In the remainder of the paper, we will attempt to unpack some of this nuance to understand how within-student differences in noncognitive factors are associated with both classroom environments and student grades. As described earlier, analyses were designed to answer three research questions:

1) Are student noncognitive factors related to student grades?
2) Are classroom environments related to student noncognitive factors and to the grades students earn in their classes?
3) Do student noncognitive factors mediate the relationship between classroom context and student grades?

Table 2. Variance Partitioning of Classroom Environments, Student Grades, and Student Noncognitive Factors

Variable	Student	Class	School	Residual (Student x Class)	Total
Classroom Environments	0.522	0.148	0.024	0.306	1.000
Student Grades	0.495	0.098	0.117	0.290	1.000
STUDENT NONCOGNITIVE FACTORS:					
Belonging	0.689	0.022	0.007	0.282	1.000
Performance Avoidance	0.586	0.015	0.025	0.373	1.000
Motivation	0.350	0.127	0.024	0.498	1.000
Learning Strategies	0.730	0.054	0.024	0.192	1.000
Academic Delay of Gratification	0.680	0.017	0.057	0.237	1.000
Self-Regulation	0.570	0.032	0.031	0.367	1.000
Class Participation	0.506	0.056	0.042	0.396	1.000

Are Student Noncognitive Factors Related to Student Grades?



A central goal prompting this research was to better understand the relationship between noncognitive factors and students' course performance, as measured by course grades, given that grades in schools are strong predictors of students' later academic and life outcomes. Specifically, could noncognitive factors be leveraged to improve student GPAs, and if so, might this be a way to reduce differences in performance among students with different background characteristics? Further,

might classroom environments be important mechanisms for improving student noncognitive variables? The BEL-S survey allowed us to examine within-student relationships between noncognitive factors and student grades, as a first step toward these larger questions.

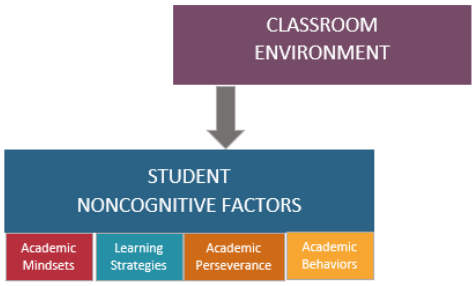
From Table 3, we see that there are significant, within-student relationships between student noncognitive factors and student grades. These relationships are small, but reliable (significant from β=0.067 to 0.111). The values indicate that, across two of their core classes, students got higher grades in the class in which they reported having a better sense of belonging, better motivation, better self-regulation, better participation, in which they were more likely to delay gratification, more likely to use learning strategies, and/or are less inclined to avoid performance. Since these results are within-student, they cannot be attributed to differences in unobserved, static characteristics of students. Note, that a standard deviation change in one of these noncognitive factors is equivalent to a 0.08 to 0.12 grade point difference in course grade from one class to another for the same student.

Table 3. Within-Student Relationships between Student Noncognitive Factors and Course Grades

Noncognitive Factor	**Relationship to Grades**
Belonging	0.083*
Performance Avoidance	-0.080*
Motivation	0.094*
Learning Strategies	0.111*
Academic Delay of Gratification	0.067*
Self-Regulation	0.081*
Class Participation	0.094*

Notes: Grades are z-standardized. Coefficients for each noncognitive factor are estimated in separate models.
Performance Avoidance *is in the reverse direction of the other measures, such that a negative score represents the desired direction.*
* significant at p <0.05

Are Classroom Environments Related to Student Noncognitive Factors?



In order to know if educators can successfully improve student grades by leveraging findings from noncognitive research, we needed to establish whether or not teachers' instructional practices and the classroom environments they create have an influence on students' noncognitive factors. Our variance partitioning exercise indicated that between 5 and 13 percent of the variation in student noncognitive factors lies between classrooms. However, a sizeable percentage

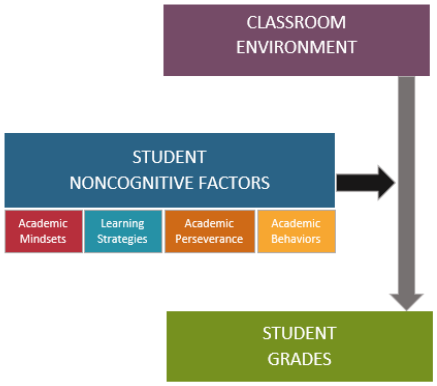
Table 4. Within-Student Relationships between Classroom Environment and Student Noncognitive Factors

Noncognitive Factor	Relationship to Classroom Environment
Belonging	0.070*
Performance Avoidance	-0.056*
Motivation	0.234*
Learning Strategies	0.134*
Academic Delay of Gratification	0.090*
Self-Regulation	0.092*
Class Participation	0.136*

Notes: Classroom environment scores are z-standardized. Coefficients for each noncognitive factor are estimated in separate models.
Performance Avoidance *is in the reverse direction of the other measures, such that a negative score represents the desired direction.*
* significant at p <0.05

of the variance over and above that was attributable to the interaction between classroom and student. The analysis presented in Table 4 shows that our measure of pupils' perceptions of classroom environment captured aspects that mattered for student noncognitive factors. There was a significant, positive, and moderate within-student association between classroom environment and motivation (β= 0.23). Classroom environment had smaller but also significant within-student associations with belonging (β=0.07), performance avoidance (β=-0.06), motivation (β=-0.23), learning strategies (β=0.13), delay of gratification (β=0.09), self-regulation (β=0.09), and participation (β=0.14). Motivation is particularly noteworthy, insofar as this is a factor that teachers often perceive as residing in a student, sometimes as a fairly stable characteristic, and outside the control of the teacher. In fact, Table 4 shows that classroom teachers and the learning environment they create can play an important role in supporting student motivation and broader noncognitive development. Students reported having higher, more positive noncognitive factors—including motivation to do well—in classroom environments which the student perceived more favorably.

Are Classroom Environments Related to Student Grades?
Do Student Noncognitive Factors Mediate the Relationship between Classroom Environments and Student Grades?



Classroom environments have a small, but reliable, positive within-student relationship with student grades (β=0.04), and this relationship is mediated by student noncognitive factors. The first row in Table 5 shows classroom environment as the predictor, with a significant relationship to grades, holding constant all the control variables, but not the classroom-specific noncognitive factors. This association was reduced considerably within students when we controlled for each student noncognitive factor one at a time, as shown in the subsequent rows. When all student noncognitive factors are introduced together in Model 9, the relationship between classroom environment and grades is virtually zero. This suggests that the classroom environment is related to student grades through its effect on the noncognitive factors that shape student performance.

CONCLUSION AND LIMITATIONS

There is growing appreciation in education for the interconnection between social, emotional, and cognitive development and the role of students' psychological experience in academic learning. This study attempted to shed some light on the ways learning environments might impact students' academic performance by supporting or thwarting noncognitive factors that motivate the perseverance and positive academic behaviors associated with school success. A critical question was the extent to which noncognitive factors were stable properties of students across contexts, or whether students experienced and exhibited measurable differences in their mindsets, motivation, use of learning strategies, perseverance, or behaviors from one classroom to the next.

Table 5. Within-Student Relationship Between Classroom Environments and Student Grades, Mediated by Student Noncognitive Factors

Mediator	Relationship to Course Grades
Model 1: Baseline Classroom Environments	0.042*
Model 2: Belonging	0.030†
Model 3: Performance Avoidance	0.035*
Model 4: Motivation	0.012
Model 5: Learning Strategies	0.008
Model 6: Academic Delay of Gratification	0.029
Model 7: Self-Regulation	0.030†
Model 8: Class Participation	0.023
Model 9: All Noncognitive Factors	0.002

Notes: Classroom environment scores and grades are z-standardized.
** significant at p <0.05*
† significant at p <0.10

Using a study design that allowed us to make within-student comparisons across two contexts, we found a reliable relationship between aggregated student reports of classroom conditions and administrative grades, which was mediated by self-reports of noncognitive factors. This is the first work to capture how the fluctuations in classroom practice that a student experiences during their school day can meaningfully shape student's mindsets, motivation, use of learning strategies, perseverance, and behavior in a way that matters for their academic performance. In other words, on average, where a student's classmates rated the classroom environment of one class more highly than another, the

student reported feeling more belonging, more motivation, less of a fear of attracting negative attention, better organization and time management, more self-monitoring of their learning, a greater likelihood of getting homework done before doing other things, and better participation in the more highly-rated classroom—and in turn, earned a higher grade in that class than in the lower-rated classroom.

Perhaps most notable is the relationship between classroom environments and motivation. In studies of teacher beliefs about motivation, we see that teachers commonly attribute low achievement to students' lack of motivation or perseverance.[22] Further, teachers often believe that motivation is a stable characteristic in students: they are either motivated to do well in school or they are not. However, when comparing a student to themselves across two classrooms, we see a sizable relationship between classroom environment and students' self-reported motivation "to do well in this class" (β=0.234). Classrooms in which students reported more teacher support, teacher organization, goal clarity, relevance, meaningful work, and a more positive classroom community were associated with students feeling greater motivation to do well than those same students reported in less highly rated classrooms. Importantly, almost all the survey items in the BEL-S classroom environment measure ask specifically about the role of teacher behaviors in fostering a positive classroom environment. (See the Appendix for a complete list of survey items for each measure.) This suggests that teachers have much more influence over student motivation than they may often assume.

These initial findings from the BEL-S provide early evidence that student noncognitive factors are malleable within classrooms, and that teacher practice can influence their development in ways associated with students' course performance. Given the strong evidence of the predictive power of course grades for students' educational attainment and longer-term life outcomes, further research is needed on the role of teachers and classrooms in supporting students' noncognitive development and academic performance. Future work that relies on rigorous experimental or quasi-experimental designs is needed to continue to build knowledge and address the limitations of the present study. Our study focused on *within-student* relationships in order to contend with the issues of causal inference and omitted variable bias in comparing students to one another. However, unmeasured course- or classroom-varying factors, such as parents' subject-specific engagement with their children's schoolwork or selection into particular classrooms, could bias our findings. In other words, our within-student design mitigated some aspects of threats to causal inference but did not eliminate them entirely.

In addition, our within-student analyses focused on the naturally-occurring difference between only two of each student's classrooms, likely resulting in restricted variation in the outcome. The magnitude of relationships between predictors and outcome is limited by our restriction in range.

Finally, reverse causality cannot be ruled out. Even though students' grades were assigned at the end of the students' term, *after* the survey was administered, students likely had a sense of their ongoing level of performance by mid-term. In our study design, we struck a balance between administering the survey at a time when students would be able to report on their experiences in classrooms, but also not know their final course grades. And in an abundance of caution, we also conducted analyses that eliminated

[22] Floden (1996); Turner, Christensen, & Meyer (2009).

the student's own self-report from the aggregation of reports that contributed to the classrooms' score. While it might stand to reason that the relationship between classroom environment and outcomes is due to the influence of classrooms on grades, it is nevertheless still possible that higher-performing students (i.e., students who would tend to get high grades) improved teachers' practice. Likewise, the relationship between self-reported noncognitive factors and grades might be due to exactly this kind of reverse causal explanation. This is not inconsistent with our original model (see Figure 1), which hypothesized recursive effects wherein student mindsets and learning strategies would drive perseverance and the academic behaviors that shape students' academic performance, and the grades students earn for that performance would in turn reinforce student mindsets, in a recursive cycle.

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APPENDIX

Becoming Effective Learners **(BEL-S) Student Survey - Time 3**

Measures, Survey Items, Question Stems & Response Scales

Measures	Survey Items	Question Stems & Response Scales
Classroom Environment	This teacher helps us see our progress as we get better and learn more. I learn a lot from the work we do in this class. The work we do in this class helps me become a better thinker. This teacher notices if I have trouble learning something. This teacher explains things in a different way if we don't understand it the first time. This teacher connects what we are learning in class to real life. The teacher explains how what we are learning in this class can help us in the future. This teacher asks for our input about what we want to learn. This teacher makes what we are learning really interesting.	How TRUE are the following about your [TARGET] class? *Not at all true, A little true, Somewhat true, Mostly true, Completely true*
	The teacher tells us ahead of time how to get a good grade on assignments. When students are absent, this teacher makes sure they get the work they miss.	In your [TARGET] class, how OFTEN does the following happen? *Never, Once in a while, About half the time, Most of the time, Always*
Noncognitive Factors		
Belonging	I feel like my classmates accept me for who I am. I feel comfortable sharing my opinions in this class. I feel like I belong when I am in this class.	How TRUE are the following about your [TARGET] class? *Not at all true, A little true, Somewhat true, Mostly true, Completely true*

	I feel like my classmates care about me. I feel connected to my classmates. I feel supported to do the work in this class.	
Performance Avoidance	I don't participate in class discussions because I'm afraid I will sound stupid. In this class, I would rather do easy work that I can do well than challenging work where I might learn more. I don't ask questions in this class because I don't want people to think I'm dumb. I stop doing work for this class if I feel like I can't do it well.	How TRUE are the following in your [TARGET] class? *Not at all true, A little true, Somewhat true, Mostly true, Completely true*
Motivation	Overall, how MOTIVATED are you to WORK HARD in your [TARGET] class?	*Not at all motivated, Only a little motivated, Somewhat motivated, Mostly motivated, Completely motivated*
Learning Strategies (Organization & Time Management)	I keep track of my assignments so I know when to turn them in. I manage my time well enough to get all my work done for this class. I keep my papers for this class well organized. I have a very effective system for managing all the things I have to do for this class.	How TRUE are the following in your [TARGET] class? *Not at all true, A little true, Somewhat true, Mostly true, Completely true*
Learning Strategies (Self-Monitoring)	When I do work for this class, I stop to check whether I understand what I'm doing. I put what I am learning into my own words to help me understand it. I review my notes carefully to make sure that I	How OFTEN do you do the following in your [TARGET] class? *Never, Once in a while, About half the time, Most of the time, Always*

	understand them. I quiz myself on the material to prepare for a test.	
Academic Delay of Gratification	I finish all of my homework for this class before I do things for fun. I put time into my work for this class even when there are more interesting things to do. I stay focused when I'm doing my homework for this class. When I have something else I really want to do, I wait until after my work for this class is done. I avoid people or things that might distract me until I finish my work for this class.	How well do these DESCRIBE YOU when you have homework in your [TARGET] class: *Not at all like me, A little like me, Somewhat like me, Mostly like me, Completely like me, I don't get homework in this class*
Self-Regulation	I have trouble paying attention in this class. I give up doing an assignment if it is taking too long. I stop trying in this class if I get discouraged.	How well do these DESCRIBE YOU in your [TARGET] class: *Not at all like me, Not much like me, Somewhat like me, Mostly like me, Completely like me*
Class Participation	Do the readings or other assigned work to prepare for class. Turn in assignments on the due date. Actively participate in class. Have all of my class materials with me. Do more than what is expected of me. Spend extra time outside of class to make sure I am well-prepared for each lesson.	In your [TARGET] class, how OFTEN do you...? *Never, Once in a while, About half the time, Most of the time, Always*