GLOBAL MINDSET — INITIATIVE —

Global Mindset Initiative: Launching a Collaborative Mission to Improve Educational Equality

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Introduction

Envisioning the Future of Growth Mindset Research in Education

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Abstract

The Global Mindset Initiative aims to develop, test, and launch a program to help teachers create a growth mindset culture for their students. A growth mindset is the belief that abilities can be developed, and research shows that students' growth mindsets can predict higher achievement, well-being, and academic equity in many nations. Research also shows that cost-effective growth mindset programs for students can enhance academic outcomes. However, effects depend on whether the classroom culture allows students to use and benefit from their growth mindsets. Thus, next-generation research must address classroom cultures directly, using experimental methods. The four papers in this series set the stage by asking: What teacher practices foster a growth mindset culture? How can we motivate enduring changes in teachers' practices? What measures best assess teacher implementation and student impact? What research designs and infrastructure are needed? With achievement, equity, well-being, and job preparation in jeopardy, the need for this kind of research is pressing.

Envisioning the Future of Growth Mindset Research in Education

A growth mindset is the belief that human abilities can develop and improve; a fixed mindset is the belief that abilities cannot change[1,2]. Over several decades, research has found that students' growth mindsets can be related to greater motivation and well-being, and more equitable academic outcomes[3–5]. In particular, students who hold more of a growth mindset tend to be more resilient after setbacks[6,7], to seek out challenges[6,8,9], and to perform better in school[3,8,10] compared to students with more of a fixed mindset. These findings have been corroborated by large, independent studies[5,11]. Further, cost-effective growth mindset interventions—which teach students how to adopt a growth mindset and put it to use—have shown effects on student achievement and academic progress in several nations[9,12,13].

Can a growth mindset become a tool for improving education systems globally? This is a pressing question. By 2030, 65% of school-aged children in the world will live in the low or lower middle-income countries [14]. Many young people will face barriers to upward economic and social mobility, including negative beliefs about the potential for economically disadvantaged youth to learn[15]. A high priority for educational researchers, then, is to develop and adapt science-based solutions, such as growth mindset, that might include more young people in our world's economic future.

Inspired by this vision, in September 2020 the Organisation for Economic Co-operation and Development (OECD) and the Yidan Prize Foundation convened a large group of scholars from around the world to discuss the global future of growth mindset research. This workshop produced three primary takeaways.

First, research to date has shown many successful replications of growth mindset effects. For example, a study using data from the 2018 Programme for International Student Assessment (PISA), which included over 550,000 adolescents from 76 nations, found growth mindset effects for student achievement and well-being in all but a handful of nations[5]. Further, large, intervention experiments which used methods for promoting rigor and transparency, such as pre-registration and independent data analysis, have found meaningful effects on student achievement and persistence[9,12,16,17].

Second, growth mindset effects are of different magnitudes in different contexts and for different populations—that is, the effects are *heterogeneous*[4,18]. For instance, in the 2018 PISA study, a growth mindset predicted student achievement more strongly for economically disadvantaged students[5]. And in both the 2018 PISA study and a randomly assigned intervention in the U.S., Growth mindset effects were stronger in classrooms that afforded more opportunity for student learning and growth[5,19]. Indeed, when classroom cultures do not create the conditions for students to apply a growth mindset to their learning, students may not profit from a growth mindset[20].

Third, the scholars concluded that the next generation of mindset research should examine

classroom culture directly, using experimental methods. This research should seek to learn how to reliably foster a classroom culture that works together with students' personal growth mindsets to promote achievement, well-being, and equity. We also need to learn how to do this cross-nationally—accounting for the fact that different cultures may create growth-supportive classrooms in different ways[21].

This final point—that we should focus not only on improving students' own mindsets, but also on cultivating supportive school and classroom cultures—suggests at least four critical challenges for global mindset research. We need to know:

1. What does a growth mindset culture in the classroom look like, and what would a classroom or teacher program involve?
2. What approaches can motivate enduring changes in teachers' growth mindset culture–building behaviors?
3. What kinds of measures should we use to assess how teachers implement growth mindset culture–building practices and how those practices affect students' outcomes?
4. What kinds of study designs and research infrastructure do we need to support this kind of research?

Answering these questions will be a daunting task. Nevertheless, the scholars at the 2020 OECD/Yidan Prize Foundation meeting concluded that not only are they answerable, but they must be answered if growth mindset research is to contribute to a brighter and more equitable future of education. In response, the Yidan Prize Foundation commissioned four working papers—one for each of these four areas of research. These papers—written by teams of experts in psychology, education, behavioral science, sociology, economics, and statistics—are collected in this series.

Of course, these papers cannot answer all of the scientific challenges; the requisite research has not been conducted. Rather, these papers aim to frame the challenges productively in order to lay the foundation for an agenda for research (to be conducted first in one context, to show that the work can be done, and then globally).

We need this framing exercise in part because past research on growth mindset has revealed many surprises and produced interestingly heterogeneous results[5,22–24]. In particular, in many school and national contexts, patterns of association between growth mindset and positive student outcomes are attenuated. Clearly, we need to learn more before we can use growth mindset to ameliorate educational inequity within and between nations.

Here, we briefly recount how scientific findings led us to the topics discussed in the 2020 OECD meeting and in the present papers. In particular, we examine research on students' growth and fixed mindset beliefs, which set the stage for our focus on the classroom's growth and fixed mindset cultures. We show how the success of student mindset interventions led us to move into the uncertain

but important terrain of intervention approaches for the broader classroom or school culture.

A Brief History of Student Growth Mindset Research

Many years ago, we asked a question: Why do some students seek out challenges and cope well with difficulty, while other students, though no less capable, avoid challenges and lose heart when they face difficulty[25,26]? This question is at the core of both student learning and effective, inclusive education—the type of education that can prepare students to contribute to society in ways that are so urgently needed.

We found that students' mindsets—the beliefs students have formed about their abilities—are part of the answer[2,25,27]. As we have said, a fixed mindset is the belief that intellectual ability is unchanging. Someone with a fixed mindset would agree with statements such as, "You have a certain amount of intelligence, and you really can't do much to change it." A fixed mindset can make challenges and mistakes more threatening because challenges and mistakes can reveal deficiencies in your permanent ability[28,29].

A growth mindset, on the other hand, is the belief that students can develop their intellectual abilities through hard work, good learning strategies, and lots of help, support, and opportunities. To a person with a growth mindset, taking on challenges and learning from mistakes become positive and desirable ways to develop abilities[9].

Growth Mindset Mechanisms

How do mindsets lead to outcomes? A decade ago, Michigan State University psychologist Jason Moser and colleagues examined the consequences of a growth mindset by watching the process as it unfolded in the brain[7]. In their study, as students confronted an error, those with a growth mindset showed strong activation in the anterior cingulate cortex—the area of the brain that processes mistakes. They not only processed the error deeply, they were also more likely to correct it at the next opportunity. Those with a fixed mindset, on the other hand, showed remarkably little processing of their mistakes. In a classroom, this process might be repeated many times and lead to greater learning and growth for those with more of a growth mindset relative to those with more of a fixed mindset[30,31].

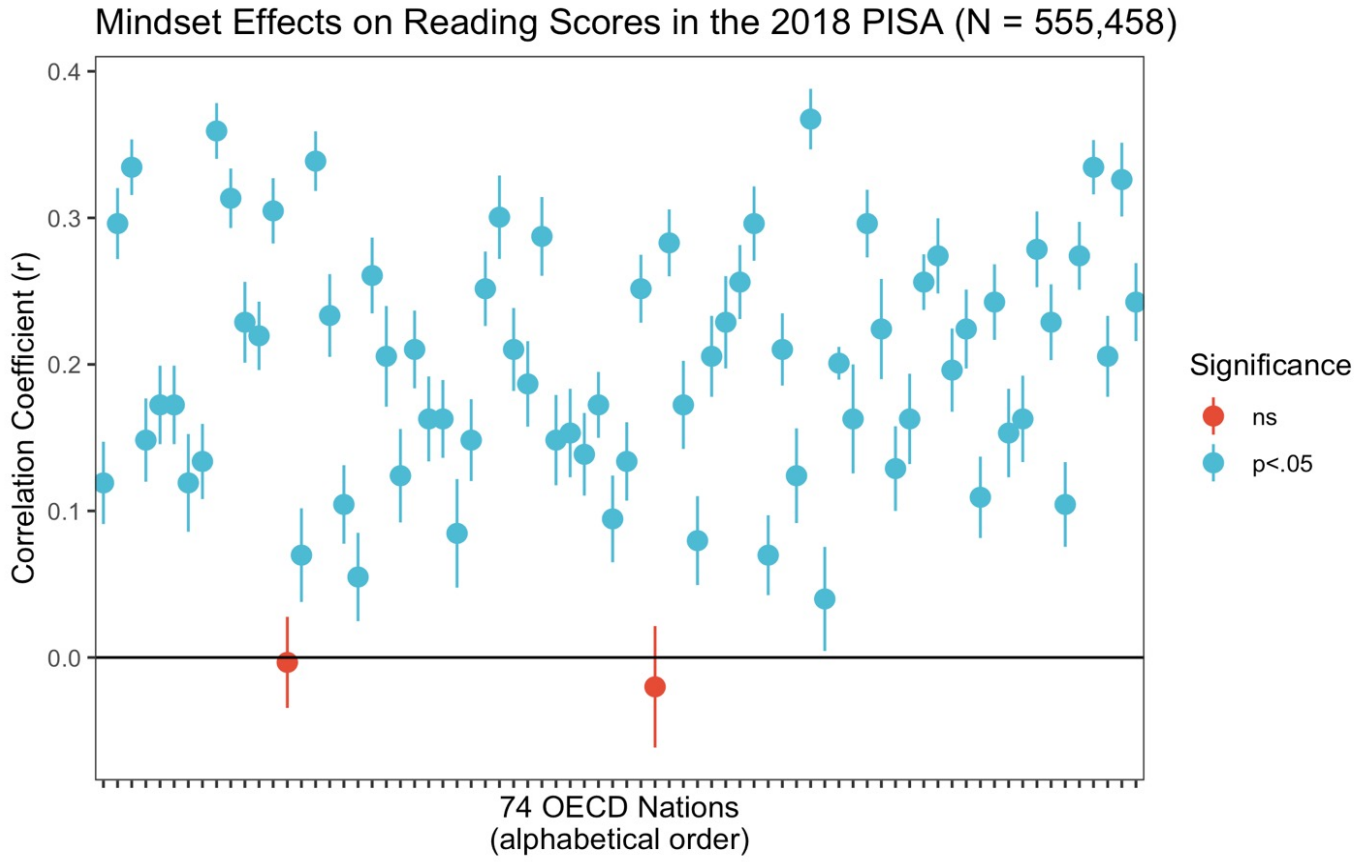
Achievement and Educational Equity

Large studies in the United States[11,12], Chile[10], and Norway[9,32] have found that measures of growth mindset predicted grades and test scores. The 2018 PISA data extended these results: in 72 out of 74 participating nations, 15-year-old students' reports of a growth mindset were significantly associated with higher test scores (see Figure 1).

The link between growth mindset and achievement is not the same for all groups of students. For example, in a study of all 10th-graders in Chile[10], low-income students were less likely to hold a

growth mindset. But when they did, a growth mindset was more strongly associated with higher test scores than among higher-income students. The 2018 PISA study produced similar results. These findings suggest an exciting possibility—that promoting a growth mindset could increase educational equity.

Figure 1. Correlations between mindset and test scores across nations in the 2018 PISA



Note: Each dot is a raw correlation between the single-item mindset measure and PISA reading scores for each nation's 15-year-olds. Bars: 95% CIs. Data Source: OECD, PISA 2018 Database, Table III.B1.14.5. Data were reported by the OECD in *SD* units; these were transformed to *r* using the standard "*r* from *d*" formulas. China contributed three different effect sizes, which are aggregated here.

Cross-National Heterogeneity

In the 2018 PISA study, the link between growth mindset and test scores varied from nation to nation. In several countries, the correlation was weak or not statistically significant; in many other nations it was larger (see Figure 1). This heterogeneity has led to many interesting questions about how to understand these cultural differences[4].

Links to Well-Being

Growth mindset is not solely an academic phenomenon; it also has many implications for psychological health and well-being[2,17]. In a study led by Hae Yeon Lee of the University of Texas at Austin,[29] 14- and 15-year-olds' mindsets were measured during the first semester of secondary school—a stressful and demanding time for many young people. The researchers also collected saliva

samples for 5-10 days to assess levels of the stress hormone cortisol, which can impair memory and learning and undermine health[33]. Adolescents with more of a fixed mindset who were also undergoing academic difficulties, such as falling grades or daily academic stress, showed higher cortisol levels and lower reports of well-being [29]. Similarly, the 2018 PISA survey found positive associations between growth mindset and well-being in many nations around the world.

Although academic success and psychological well-being often go together, sometimes they do not. For instance, the pressure to perform well on tests can cause undue anxiety and worry. Interestingly, some of the strongest relations between growth mindset and well-being in the 2018 PISA were found in places that had the weakest link between growth mindset and test scores [4]. This suggests that a fascinating area for future research will be the intersection (versus non-intersection) of academic and well-being outcomes.

Growth Mindset Interventions

Can mindsets be changed? Early researcher-designed studies that delivered in-person growth mindset programs showed that it can, and that changing students' mindsets can enhance achievement[8,34]. But several small-scale studies using interventions developed by educators failed to shift mindsets[22]. This suggests that we need standardized interventions that reliably change mindsets, that are rigorously tested in large randomized trials, and that can cost-effectively be scaled to reach entire national populations.

In the United States, the National Study of Learning Mindsets (NSLM)[12,16,19] developed and evaluated such a program. The growth mindset program was distilled to under an hour, put online, sent out to a nationally representative sample of schools, and self-administered by students who were making the difficult transition to secondary school. In two pre-registered U.S. experiments in the[12,16,19], and in two replications conducted in Norway[9,32], the short online intervention succeeded in shifting students' mindsets. Despite its brevity, the program produced meaningful (although modest) effects on students' grades and progress toward graduation. For example, in both Norway and the U.S., the intervention increased by three percentage points the rate at which students took more advanced math classes one year after the study[9,12].

From Heterogeneous Effects to School and Classroom Culture

Standardized, online growth mindset intervention studies conducted in large national samples have shown that a growth mindset can improve students' academic outcomes. Their greatest contribution to mindset science, however, is not that they demonstrated the interventions' effectiveness on average. Rather, it was what they revealed about contexts where the programs did not work. The finding of meaningful variation in outcomes is leading to new research to find what

distinguishes the classroom cultures that produce the greatest growth mindset benefits.

In the U.S., NSLM revealed that teachers' mindsets influence students' mindsets: When teachers themselves held more of a growth mindset, they created a classroom culture in which their students' new growth mindsets could take root and turn into enhanced achievement[19]. Similarly, the international 2018 PISA study found that teacher practices play an important role in sustaining students' growth mindsets and boosting their effects on achievement[5].

These findings have important implications. Policymakers should not aim to put a growth mindset into students' heads and then turn them loose. Nor should students be blamed or chastised for having the "wrong" mindset. Rather, policy should aim to create classroom cultures in which a growth mindset—and a zest for learning, challenge, and mastery—can take root and flourish. These are culturally sensitive and inclusive classrooms that:

- value all students' learning equally,
- emphasize understanding and progress, and
- help all students learn from their setbacks and struggles.

The educational research community is shifting toward an emphasis on mindset culture and how it supports the mindsets of individuals. This research is rooted in the pioneering work of Mary Murphy, Stephanie Fryberg, and others who, for the last decade, have come to view growth and fixed mindsets as cultural variables that shape an educational setting's effectiveness[21,35–38]. They have shown, for instance, that teachers' mindset beliefs and practices are related to the degree of inequality in their classrooms[36]. This cultural approach to mindset research sets the stage for the next decade of mindset science.

A Collaborative, Global Future

As research on growth mindset has grown in popularity, growth mindset approaches have been implemented or evaluated by a wider group of educators and researchers. This expansion of growth mindset research has likely produced some innovations, but it has also led to varying results and some degree of confusion[22]. Indeed, a national survey of U.S. teachers[39] revealed many misunderstandings about the very definition of a growth mindset. A substantial proportion of teachers incorrectly equated growth mindset with simply praising effort[39]. And even many teachers who correctly understood a growth mindset still reported that they were unsure how to act on it. Just 20% of the teachers felt confident they could integrate growth mindset practices into daily classroom instruction[39].

Growth mindset researchers should tackle these challenges head on. Teachers need and want effective practices that help them create growth mindset classroom cultures, and the global research enterprise—ourselves included—has a responsibility to do something about it.

That is what our series of working papers is about. The four papers will form the foundation of the Global Mindset Initiative, a new global research collaborative that builds on data from the PISA study, on recent large student mindset intervention experiments such as the NSLM, and on the pressing needs of educational practitioners. The Global Mindset Initiative will develop, test, and launch a program that guides teachers in creating a growth mindset culture for their students. Within the next decade, we aim to evaluate and scale the teacher-focused program in many of the OECD nations that participate in the PISA, and, in each country, to produce measurably large effects on educational equity and well-being from rigorous randomized trials.

To generate a proof of concept, we have launched a statewide study and research infrastructure in the U.S. state of Texas. This prototype, called the Texas Mindset Initiative, will develop a preliminary set of teacher interventions, measures, and research designs. Once it is determined to be effective, this suite of tools can then be re-imagined with partners in the Global Mindset Initiative. Our four working papers are intended to lay the theoretical foundation for this Texas evaluation study and for later adaptations that will come out of the Global Mindset Initiative.

How the Working Papers Create a Roadmap

The first paper, by Murphy, Fryberg, and colleagues, asks: What practices should we target to help teachers cultivate a growth mindset culture? This paper presents major findings from the ample educational research on effective teacher practices. It also uses the growth mindset framework to understand those findings in terms of creating a growth mindset culture. Thus it paves the way for research on identifying and evaluating the highest-impact practices for teachers and schools.

The second paper, by Christopher Bryan and colleagues, asks: Once we know the most effective practices, how can we motivate teachers and prepare them to implement those practices in the face of the many substantial demands on their time and attention? After reviewing the emerging science of how people are motivated to implement new behaviors and integrate them into their ongoing practices, the paper proposes a framework for aligning growth mindset culture change with teachers' existing fundamental goals.

The third paper, by Kali Trzesniewski, David Yeager, and colleagues, asks: How would we know whether a teacher or school has implemented growth mindset culture-building practices effectively? The paper sets forth a plan to serve as a guide for developing measures that can assess changes in the classroom culture. In particular, it shows that measuring teachers' intentions to implement a practice is not enough; if we want to truly understand a classroom's mindset culture, we also need to know what practices teachers actually implement and how students perceive those actions.

The final paper, by Elizabeth Tipton, Larry Hedges, and colleagues, asks: Given that even an

intervention in one country would require large amounts of resources and organization to recruit sufficient teachers and schools, as well as large teams of collaborating scholars, how can we even begin to envision accomplishing this on an international level? Many countries cannot readily support research of this magnitude. This paper suggests innovative research designs that re-imagine the path to scaling interventions by focusing on heterogeneous effects. It also suggests that if we are to support rapid and repeated trials in diverse and informative contexts, we will need a collaborative, team-science-based infrastructure—one with the ability to link and analyze data quickly, as well as to select sites for experiments with an eye to heterogeneity.

Finally, we asked several researchers and practitioners to reflect on the papers and offer their perspective. These commentators bring diverse experiences to the Global Mindset Initiative, such as founding large, successful networks of exceptional schools in the U.S. and Colombia, as well as expertise in economics and large-scale experimentation. These authors explain how they believe the working papers fit with the state of the research and the highest priorities for the field.

Conclusion

With so many students falling behind, with growing inequality and psychological distress[40], and with so many modern jobs requiring advanced, technical skills[41–43], there has never been a more important time to figure out the challenges we have raised. All students should be able to dream about those highly skilled jobs, and they deserve to be guided, every day, along a path that will get them there. In our pandemic-ravaged world, can we afford to lose even a single student's contribution to society? We don't think so.

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Initiative Paper 1

Growth Mindset Cultures and Teacher Practices

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Keywords: growth mindset, interventions, inequality, motivation, education, classroom cultures, teacher beliefs, teacher practices

Abstract

This article forwards a vision for enhancing equity and educational outcomes by creating growth mindset cultures in schools and classrooms. In growth mindset classroom cultures, teachers provide a coherent meaning system for students' mindsets, goals, beliefs, and behaviors. By normalizing and infusing growth mindset beliefs and behaviors into routine practices and interactions, these classroom cultures give students (and teachers) a shared and productive way to understand challenges, setbacks, and learning inside and outside the classroom, ultimately benefiting their longer-term academic trajectories. In describing the possibility and promise of growth mindset cultures, we focus on the role of teachers and their instructional practices in creating these cultures. We provide a framework for integrating evidence-based instructional practices and growth mindset research. Finally, we chart an ambitious research agenda describing questions the field must answer if we are to create effective growth mindset cultures that spur students' motivation and learning in school.

Growth Mindset Cultures and Teacher Practices

Imagine a classroom where all students are so eager to learn that they brim with excitement when presented with challenging material. In this classroom, students who make mistakes or don't understand a new concept don't experience shame or attempt to hide their confusion. Instead, when they are stuck, they shift strategies, ask for help, and try a different approach. The teacher has normalized struggle and confusion, framing them as part of the learning. The teacher has also made sure that progress, development, and mastery—rather than effortless, perfect performance—are praised and rewarded.

How do the students interact with each other in this classroom? Cooperation and collaboration supersede competition, as students look out for one another and ensure no one is left behind. Teachers and students alike view students from diverse backgrounds as assets who bring different experiences and learning strategies that strengthen the community. This supportive, growth-oriented can also eases the teacher's burden because they know they can rely on students to show up ready to learn and help one another. The teacher, in fact, is able to focus on what attracted them to the teaching profession in the first place: helping students learn deeply and develop as they progress through life.

This classroom may be hypothetical, but we believe it can become more of a reality when we understand how to help teachers create classroom cultures that operate with a growth mindset at their core. *A growth mindset* refers to the belief that intellectual abilities are malleable and can be developed through effective effort, the use of good strategies, and help and support from others[1]. On the other hand, a *fixed mindset* refers to the belief that intelligence is an innate and unchangeable characteristic. Based on past research, we propose that growth mindset classroom cultures are likely to support and galvanize student motivation, behavior, and performance by giving students an adaptive way to make meaning from everyday academic experiences.

Research shows that students guided by a growth (vs. fixed) mindset tend to pursue goals that emphasize mastering challenges (as opposed to goals designed to bring positive and avoid negative judgments of their ability). They tend to view failures and setbacks as signs that they need to exert more effort and try new strategies (rather than as signs that they lack ability), and they tend to see mistakes and confusion as an important part of the learning process (rather than an indicator of limited potential) [2–4]. This means that the same event can elicit very different interpretations and reactions from students when they view it through different mindsets.

For example, when students receive a disappointing grade on an exam, their mindsets—and the "meaning systems" that grow out of these mindsets—are likely to shape their reactions. A student operating from a fixed mindset believes intelligence is a stable, unchangeable trait. Thus, they are likely to interpret their disappointing grade as a reflection of weak ability that they can't do much to change.

They may come to see their exam grade as an indicator that they aren't cut out for school, which may lead them to expend less effort and further depress their performance[5]. A student operating from a growth mindset, however, believes that intellectual ability is a potential that can be developed. Instead of interpreting a disappointing grade as an indicator of a fixed lack of ability, they can view it as a sign that they need to exert more effort, seek help, and use different strategies when preparing for the next exam. Because they believe that they can develop intelligence and ability, they are more likely to take the steps to do so. Such students may respond by giving themselves longer to prepare for their next exam, asking their teacher for guidance about how they can improve, or reaching out to peers to start a study group[3].

However, a growth mindset is not just a belief in a student's head; it can also be a philosophy that is embedded in the culture of the classroom. Growth mindset classroom cultures provide a coherent meaning system for mindsets, goals, beliefs, and behaviors. By normalizing and infusing growth mindset beliefs and behaviors in routine practices and interactions, these classroom cultures give students (and teachers) a coherent way to understand and respond to events inside and outside the classroom. By offering students a cohesive way to make meaning of success, failure, and effort, growth mindset classroom cultures can allow students to reap the benefits of a growth mindset as they apply it over and over again in their academic work, ultimately benefiting their longer-term academic trajectories.

And yet there is much we need to know before teachers, administrators, and researchers can make these growth mindset classroom cultures a reality. This paper is a first step in charting an ambitious research agenda to achieve these goals.

Classroom Contexts and Heterogeneity in Students' Outcomes

More than a decade of social psychological research in both the lab and the field has shown that growth mindsets can enhance students' academic motivation and performance, even among students who face barriers to success[6,7]. Given their effectiveness and their relatively low cost, educators have shown enthusiasm for harnessing the power of growth mindset interventions with students[8,9]. Yet the evidence suggests that students' personal mindsets are often not enough; instead, the students need to be in a classroom environment where they can readily put their growth mindset into practice and reap its benefits. That is, studies have found that student-focused mindset interventions, even when they are successful, can have varied effects on students' achievement, with students in some classrooms reaping more benefits than students in others[10,11]. What explains these differences? One answer seems to be the mindset and teaching practices embedded in the classroom by teachers who create the learning culture. When the classroom resembles our hypothetical classroom, the idea of the growth mindset—that everyone can significantly increase their skills and

abilities—is embedded in what the teacher says and does, how material is taught, and how students interact with one another.

For example, in a recent nationally-representative study of a student-focused growth mindset intervention in the United States[11], researchers found that though the intervention boosted students' growth mindset beliefs, students could not always put their growth mindsets into practice. Instead, to get the benefits, students' mindsets had to be supported by their teachers' mindsets. Thus, while students' growth mindset beliefs are important to their success, they also require a classroom culture that values and encourages their growth mindset beliefs and behavior.

By working with teachers to change classroom culture, we can better understand why mindset interventions have differential effects and help researchers, teachers, and administrators identify more effective and sustainable interventions. The vast majority of today's interventions focus on changing individual students' mindsets. Yet many of the messages students encounter in their schools (e.g., pressure to make strong performance appear effortless or competition for performance-based accolades and opportunities) contradict the core tenets of a growth mindset and may thus counteract the positive effects of student-focused mindset interventions. In contrast, interventions that train educators to create a growth mindset classroom culture—by promoting growth mindset values and implementing rituals, routines, and policies that align with and support growth mindset beliefs and behaviors—can potentially enhance students' long-term academic motivation, engagement, and performance.

How to help teachers change their practices to create growth mindset classroom cultures is an important theoretical and practical question, and emerging research suggests some promising avenues. However, teacher-focused interventions may be more effective if they do not ask teachers to directly teach students about the growth mindset or attempt to "instill" this way of thinking. Why? Because when teachers try to teach growth mindsets in a didactic, prescriptive way, students may perceive the teachers as controlling—as telling them what to think--and react negatively[12,13]. Indeed, one such approach was tested in primary and secondary schools in England and was largely ineffective[14]. Further, we contend that changing teachers' mindsets is not sufficient to change classroom cultures, as individuals' beliefs do not necessarily predict their behaviors[15]. That is, endorsing a growth mindset does not guarantee that a teacher will communicate this mindset to students or support students in developing or sustaining growth mindsets. Instead, we propose that teacher-focused interventions may be more successful when they help teachers change, not their mindsets per se, but their teaching practices in ways that value, encourage, and support students' growth mindset beliefs and behaviors.

Growth Mindset Classroom Cultures

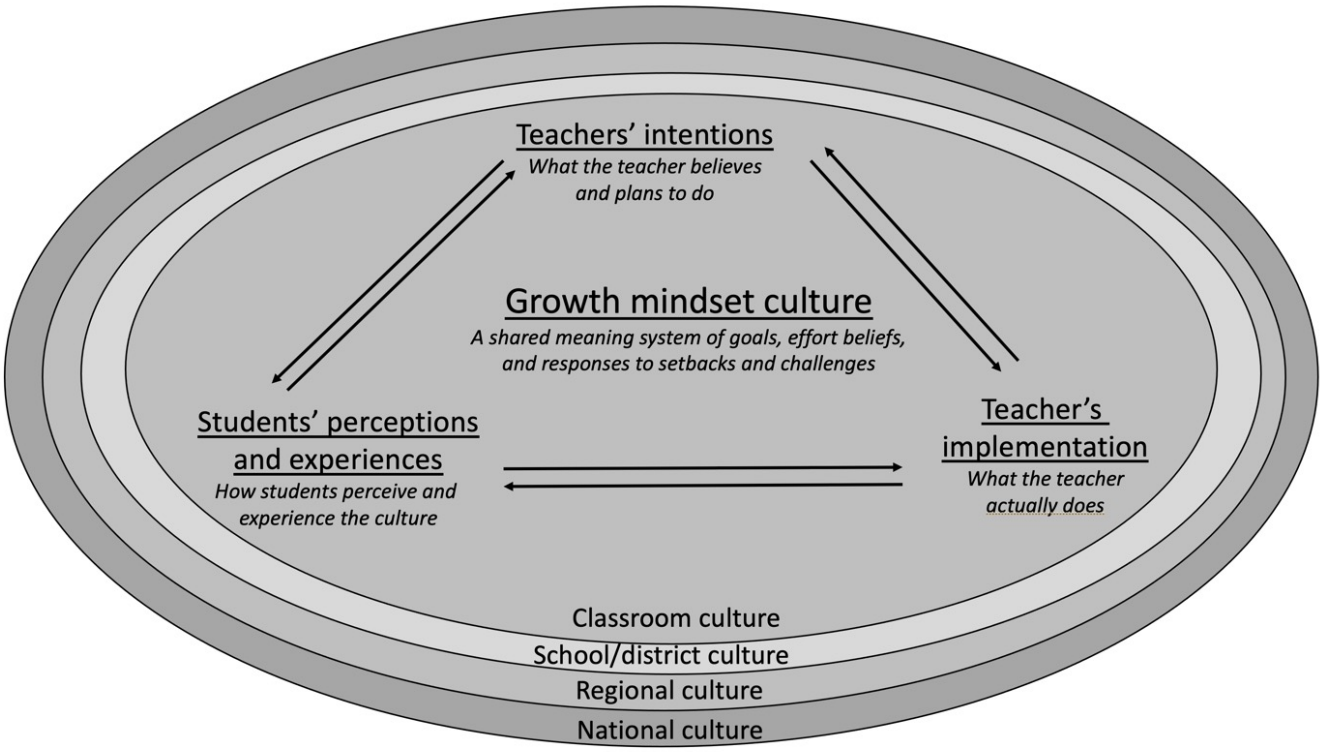
The concept of a growth mindset classroom culture is rooted in Alfred Kroeber and Clyde Kluckholn's[16] classic definition of *culture*, which centers on the mutually reinforcing relationships between individuals and their surrounding social contexts. Individuals' behaviors and understandings of the world are shaped by the explicit and implicit messages and values embedded in their surroundings (e.g., in norms and laws, societal institutions, interactions between people, and cultural artifacts). Like other influential theories of culture[17,18] this understanding situates *core ideas* or beliefs as the driving force behind the norms and behaviors in a given context. In the context of education, classroom cultures encompass the beliefs and values (i.e., core ideas) that educators—whether consciously or not—uphold for students, as well as the everyday behaviors and interactions that follow from these beliefs and values.

There are a variety of core ideas or belief systems that educators can adopt (e.g., brilliance beliefs, universal-nonuniversal beliefs). For example, brilliance beliefs focus on whether people believe that brilliance is what it takes to reach the very pinnacle of success in their field (or not)[19]. Similarly, teachers can endorse "universal" (i.e., everyone can be successful) or "non-universal" (i.e., only a few people can succeed) beliefs[20]. These core ideas have been conceptualized as empirically distinct from the more traditional, "Dweckian" beliefs about the fixedness or malleability of intelligence[20,21]. For example, one can believe that what it takes to be at the top of a field is brilliance but they can conceive of brilliance as something that is fixed (you either have it or you don't) or as something that is malleable (i.e., something that one can develop). The focus of this paper complements this work by examining how more traditional fixed-growth mindset beliefs create and sustain classroom culture. As we have noted, in growth mindset classroom cultures, teachers communicate the primary idea of the growth mindset meaning system: that students have great potential and capacity for intellectual growth. They do so through what they say to students (e.g., the language they use to motivate students), class policies (e.g., classroom rules and agreements), and the rituals, routines, and practices they use to get students engaged and to structure classroom interactions.

How do we know when a classroom has a strong growth mindset culture? Theoretically, we might consider three aspects: (a) teachers' beliefs and intentions for the culture they plan to create; (b) teachers' implementation of the culture, communicated by what they do and say during the school year; and (c) students' expectations for and perceptions of the classroom culture—including their experiences in the classroom throughout the school year. While these factors are related, as the model below suggests, we believe that they are distinct in their manifestation and impact. Strong growth mindset classroom cultures are likely to emerge when *teachers intend* to uphold growth mindset beliefs, when the intention is manifest in their *implementation* of teaching practices, and

when *students' perceive and experience* the growth mindset beliefs and behavior as normative and supported (see Figure 1).

Figure 1: Growth mindset culture comprises teachers' intentions, implementation, and students' perceptions and experiences.



Notably, what a growth mindset classroom culture looks like is likely to vary from one cultural context to another. Much of the research on growth mindset has been conducted in the West, where cultural norms are typically independent and societies demonstrate a high level of individualism[22–24]. In many ways, both the scientific understanding and lay application of growth mindsets reflect the cultural context of the researchers and practitioners who have led the charge of using growth mindset to create educational change. Consistent with independent cultural norms, growth mindset interventions largely focus on equipping individuals with growth mindsets, and the motivational messages (e.g., "If you work hard on challenging tasks, you can grow your brain") focus on the benefits of growth mindset beliefs and behaviors to individuals. Yet, much of the world's population lives in contexts where cultural norms are more interdependent and societies demonstrate high levels of collectivism[22–24]. How teachers can effectively convey growth mindsets to students in these interdependent contexts is likely to differ from how teachers convey growth mindsets in more independent contexts. Teachers may, for example, focus on helping students in interdependent cultures adopt a collective identity as a class who believes that they can work together to grow as a

group. Rather than focusing on the benefits to individuals, teachers may help students recognize how growth mindset beliefs and behaviors are beneficial to their family and communities (e.g., by working hard to grow, you can set a good example for your younger siblings). While the goal of creating growth mindset classroom cultures is one that can be applied and studied broadly across cultural contexts, special attention must be paid to avoid a one-size-fits all approach to creating these cultures.

Teachers Impact Students' Academic Experiences and Outcomes

Though culture can change via many pathways, research indicates that working with teachers is a promising avenue. In the following sections, we discuss the critical role teachers play in shaping their students' motivation, engagement, and performance, focusing in particular on the practices, routines, and rituals that appear to be most effective for enhancing students' learning experiences. The research on how teachers impact students has developed without necessarily directly considering the empirical findings regarding mindsets. However, many teacher practices that we already know to be effective are congruent with the growth mindset meaning system and could be combined and integrated to create growth mindset classroom cultures. Moreover, as we will suggest, viewing these practices through a mindset lens may organize them into a more coherent system, one that is perhaps easier and more motivating for teachers to adopt than a seemingly disparate array of individual practices.

Research consistently indicates that teachers exert an important influence on students' academic outcomes. Much of this work, conducted principally by education researchers and economists, estimates teachers' "value-added" contribution to students' academic outcomes, such as test scores. Value-added models examine how students' outcomes vary from teacher to teacher, statistically accounting for other factors that may also affect these outcomes, such as students' prior achievement and demographic characteristics[25,26]. This approach reveals substantial variability in teachers' effectiveness[27–39]. For example, a summary of these value-added estimates indicates that, on average, having a math teacher at the 75th percentile of effectiveness rather than the 25th percentile of effectiveness would move a student from the 50th percentile of math achievement to approximately the 58th percentile by the end of the school year[39].

But teachers' influence goes beyond just achievement. Effective teachers (i.e., those who have high "value-added" ratings in these analytic models) enhance students' motivation, social-emotional outcomes, and behavioral outcomes (such as avoiding suspensions)[33,34,40–46]. In one study, in fact, teachers' value-added ratings were significantly associated with fourth- and fifth-graders' growth mindset beliefs in the United States; that is, the more effective teachers were, the more their students endorsed growth mindset beliefs[33]. Overall, research suggests that teachers affect student performance directly and indirectly, the latter via improved psychological, social-emotional, and

behavioral outcomes. But the value-added research does not tell us the precise mechanisms by which teachers shape student outcomes.

What Makes Teachers Effective? Teacher Practices and Teacher Mindsets

What teacher characteristics are associated with improved academic performance, behavior, experiences, and beliefs among students? That is, what makes teachers "effective"? Two strands of research have approached this question from different theoretical perspectives. First, many studies, primarily by education researchers, have identified specific teacher practices that predict improved student outcomes. The second and more recent strand of research, primarily by psychologists, indicates that teachers' actual and perceived mindsets are meaningfully associated with student outcomes. In this section, we review the empirical evidence from each of these strands. We then propose that organizing classes around the growth mindset meaning system can enhance teacher efficacy and student outcomes by harmonizing otherwise disparate categories of practices and beliefs. From the perspective of teachers, creating a growth mindset classroom culture could make individual practices feel more consistent and seamless to enact (rather than list-like and disconnected). From the perspective of students, such a culture could create a more cohesive perception of the classroom environment, where the teacher's beliefs, motivation, and expectations for behavior are clearer. In fact, having a coherent meaning system centered on the idea that students have great potential and capacity for intellectual growth may even amplify the positive effects of teacher practices as teachers say and do things in the classroom that make the growth mindset idea come true.

Education Research on Teacher Practices

Over more than a century, theory and research have sought to identify the practices that distinguish more and less effective teachers. Examining specific teacher practices is important not only because these practices can be concretely linked to student outcomes, but also because they provide a window into teachers' ongoing role as reflective practitioners who continually experiment with and learn from their practice. Reviewing the entire body of teacher practices research is beyond the scope of this paper (but for reviews[47–49]). Instead, we draw on insights from particular educational frameworks[50–54]ones that highlight effective teaching practices by examining the associations between teachers' observed behaviors in the classroom and students' academic achievement, behavior, and positive classroom experiences[40,55–58].

Teaching practice frameworks. The Measures of Effective Teaching (MET) project is the largest study that compared different frameworks for evaluating teaching practices[57]. Researchers collected videotaped lessons from a large sample of fourth- through eighth-grade teachers in the United States and evaluated them using five of the best-established practice evaluation frameworks[50–54].These frameworks assessed teachers' use of many different practices, such

as including all students in class activities, using engaging learning formats, and setting clear instructional outcomes. (We synthesize and review these practices in greater detail below.) Scores on each of the five teaching evaluation frameworks significantly predicted students' state test scores, their effort, and their feelings of emotional attachment to the teacher. The magnitude of the effects did not differ greatly between the five frameworks, and none of the practices covered by these frameworks was found to predict student outcomes substantially more than the others[50–54].

Other research focused on individual teaching evaluation frameworks reveals similar effects of teachers' practices on students' intra- and interpersonal outcomes in school. For example, higher teacher scores on the Mathematical Quality of Instruction (MQI) framework[54] were associated with greater math self-efficacy, happiness, and positive behavior among fourth- and fifth-grade students in the United States[40]. Similarly, higher teacher scores on the Classroom Assessment Scoring System (CLASS) were associated with improved peer interactions and teacher-student relationships among elementary school students in the United States[58]. One recent study used the CLASS to evaluate 51 7th-grade math teachers in Chile and found that scores on this assessment were positively associated with teachers' ability to keep students engaged[59]. In sum, findings from the MET project and other studies indicate that teachers' practices are consequential both for students' academic achievement and for their psychological experiences and behavior.

Categories of effective teaching practices. One likely reason that the five teaching practice frameworks examined in the MET study demonstrated similar impacts on student outcomes is that the practices identified in the frameworks overlap extensively. To organize the effective practices that emerged from these frameworks, we assessed the conceptual overlap between the competencies described by the frameworks and evaluated the extent to which they align with the growth mindset meaning system. We then sorted those competencies into four categories that were both broad enough to include a range of practices and distinct enough to discern meaningful differences between categories. Although the teacher practice frameworks from which these categories are drawn were tested principally in the United States (e.g., in the MET study), they also overlap considerably with international guides on best practices for creating supportive and inclusive classrooms[60].

- ***Category 1: Inclusive classroom environments tuned to learning.*** Teachers' proficiency in creating inclusive environments is often assessed in terms of their ability to develop positive relationships with all students and to create a community of learners in which all students contribute to the development of the whole. Effective teachers do this by showing regard for different student perspectives and developing mutual respect and rapport[61]. These teachers intentionally include all learners in class activities[62,63], draw connections to students' personal and cultural experiences[64,65], and manage their personal biases and prejudices[66]. Inclusive classroom environments are also measured in terms of how teachers create peer cultures tuned

to learning. Effective teachers establish and maintain a peer culture in which the classroom norm is to value learning[50] and where students support one another's learning, challenge-seeking, and development[61].

- ***Category 2: Organization and class management.*** This dimension is often assessed in terms of teachers' ability to manage student behavior and disruptions, and to set classroom rules and norms that make class sessions go smoothly[67]. Teachers' organization and class management is also assessed by how they manage class time. For example, more effective teachers carefully track and manage students' time on task[68] and use instructional learning formats that keep students engaged throughout a lesson[69].
- ***Category 3: Supportive instruction and assessment.*** Whereas Category 1 (creating an inclusive classroom environment tuned to learning) describes how teachers shape teacher-student and student-student interactions in the classroom to value learning, this category describes teachers' instructional skills when it comes to teaching the content of their lessons and assessing students' learning and progress. Supportive instruction is often assessed by observing teachers' use of effective pedagogical techniques, including modeling[70], offering challenging questions and activities[71], providing high-quality examples, explicitly discussing technical language and terminology, verbalizing proof and reasoning[72], and anchoring new material to students' prior knowledge[73]. Supportive instruction is also assessed by observing how teachers guide students' learning—for example, whether teachers interpret students' questions correctly, address their misunderstandings[54], and use effective questioning and response techniques to create generative extended discussions[50]. Finally, supportive instruction is measured by examining the quality of feedback that teachers provide to students and whether they use formative assessments to track students' progress and improvement[74].
- ***Category 4: Planning and preparation.*** Whereas Category 2 (organization and class management) describes what teachers do during class sessions, this category describes how teachers prepare for those sessions. For example, effective teachers prepare to teach by ensuring that their own knowledge of the content and pedagogy is strong[75]. Effective teachers also prepare by integrating their knowledge of their students into the course content, including characteristics of their students such as their differing goals, values, and cultural backgrounds[64,65]. Finally, effective teachers prepare by identifying clear instructional and learning outcomes for individual class lessons and units[50]. For example, an algebra teacher may plan for students to understand slopes by the end of a particular lesson and have a greater mastery of linear equations by the end of the unit in which that lesson was embedded.

As we have noted, educational research identifies a number of teaching practices that are positively associated with student outcomes. Yet this research has been largely descriptive,

leaving unanswered questions about the mechanisms by which these practices work, how students interpret the meaning of these practices, the extent to which these practices work for students from different backgrounds and cultures, and how these practices may work with each other. Considered individually, these practices appear list-like and relatively unconnected to each other or to a larger classroom goal or value. Yet when taken together, many of the practices seem to align with the growth mindset meaning system—they focus on students' learning and development, and many practices (such as those that create inclusive classroom environments or supportive instruction) are likely to communicate to students that everyone can substantially increase their intellectual ability. Though educational research has largely focused on observing discrete teaching behaviors and associating them with students' achievement, psychological research on teacher mindsets and practices has focused more on understanding how teachers' mindset beliefs and behaviors are perceived by students—and how these beliefs and behaviors influence students' psychological outcomes, behavior, and achievement.

Psychological Research on Teacher Mindsets and Practices

Evidence is growing that teachers' actual and student-perceived mindset beliefs affect students' own experiences, motivation, and performance in the classroom. When students perceive that their teacher endorses a growth mindset, they are more likely to act in line with the growth mindset meaning system. That is, they are more likely to put in effort, seek help, and work through different strategies to reach their goals[20,21,76,77]. For example, Muenks and colleagues[21] found that when college students in the United States perceived their teacher to strongly endorse growth mindset beliefs, they experienced more positive psychological outcomes in class (e.g., a greater sense of belonging, less stress about being evaluated on their academic ability, fewer imposter feelings, and less negative affect), which in turn predicted greater classroom engagement and higher end-of-term course grades. These findings were robust, persisting even after the researchers controlled for students' own mindset beliefs and their perceptions of teachers' warmth and competence. These findings suggest that students' perceptions of their teachers' mindsets are a unique and potentially important predictor of students' psychological experiences, behavior, and achievement in the classroom.

When teachers communicate a growth mindset through what they say and do, it seems to have positive consequences for all students in the classroom[21,76,78]. For example, a university-wide study involving over 15,000 college students enrolled at a large, selective public university in the United States revealed that students earned higher grades and were more motivated when their STEM instructor endorsed more growth (as opposed to fixed) mindset beliefs[78]. However, for students who belong to groups that are subject to negative stereotypes regarding their ability and intelligence (e.g., women and girls in STEM classes; racial-ethnic minority students in school in general), teachers who communicate growth mindsets can create a more identity-safe learning environment. That is, when

teachers communicate a growth mindset, students who belong to negatively stereotyped groups feel valued and respected, and they are less worried about being reduced to negative stereotypes[76,78]. The study also found that the positive impact of teachers' growth mindsets was especially strong for racial-ethnic minority students. In fact, in courses taught by instructors who more strongly endorsed a growth (versus fixed) mindset about ability, the racial achievement gap in end-of-term course performance was halved[78]. Similarly, in a follow-up study, when students perceived their STEM instructors to endorse more growth (versus fixed) mindset beliefs, the end-of-term gender achievement gaps in those courses were significantly narrowed[79].

How do teachers' mindset beliefs shape their students' outcomes? Teachers' beliefs likely influence students via what they say and do in class—that is, by their classroom policies, teaching practices, and their interactions with students. For example, research shows that when teachers quickly judge students' abilities and recommend that struggling students drop difficult courses rather than seek help, they implicitly communicate fixed mindset beliefs[80,81]. But teachers who communicate growth mindset messages can reverse these perceptions and motivate students to seek help and approach challenging tasks as learning opportunities[20,78].

In an experimental lab-based study with college students in the United States, communicating a growth (rather than fixed) mindset via a college math course syllabus reduced the gender gap in performance on a standardized math test by reducing women's concerns that they would be stereotyped as less capable at math and increasing their feelings of belonging[79]. In this study, the course syllabi activated the growth mindset meaning system by offering students mindset-congruent ways to view and interpret specific policies and practices. For example, in the growth mindset syllabus, the teacher encouraged attendance, revision, and help-seeking for all students. Why? Because the teacher believed that everyone can develop their skills and challenge themselves. In the fixed mindset syllabus, the teacher focused more on valuing perfect performance and categorizing students' ability levels, communicating the belief that some students are naturally gifted in math while others are not. In another study with United States undergraduates, an instructor built trust in part by communicating a growth mindset, which increased students' course engagement and improved their grades[82]. Finally, a study found that instructor communications that contained growth mindset messages increased help-seeking (i.e., attending tutoring sessions) and grades among underrepresented college students in the United States[83]. This work shows that teachers' mindset beliefs—and students' perceptions of those beliefs—play an important role in students' psychological experiences, behavior, and performance.

Making Shared Meaning of Effective Teaching Practices

The psychological research on teacher mindsets reviewed above starts from a central motivating idea—the growth mindset—and examines how communicating to students that everyone

can learn and develop their intellectual abilities shapes students' outcomes. This central idea serves to organize and align teacher practices so that they holistically influence students' goals, beliefs, and performance. This research has identified some practices, and more often combinations of practices (e.g., first day of class lectures, syllabus language, revision policies, and feedback practices), that together communicate teachers' mindset beliefs and influence students' outcomes. By comparison, education researchers have done more to observe and categorize actual classroom teaching according to practice evaluation frameworks—taking a more bottom-up approach by observing what teachers do, grouping them into empirically derived categories, and then associating the practices with students' outcomes to determine which practices are effective. What appears lacking, however, is a framework that ties these effective practices together to help teachers and students draw shared meaning from them. To bring the psychological and educational research together, we need a shared conceptual framework for understanding teacher practice and helping teachers implement effective practice in a systematic, cohesive way to enhance students' experiences and learning outcomes.

The goal of creating growth mindset classroom cultures can provide a motivating conceptual framework for understanding how a range of seemingly distinct teaching practices may work together to create a unified experience for teachers and students and promote shared interpretations of and responses to academic successes, failures, challenges, setbacks, and effort—all rooted in the belief that students are capable of intellectual growth.

Creating Growth Mindset Classroom Cultures

Growth mindset classroom cultures allow all students to experience and act on the belief that they have great potential to learn. Creating such an environment is challenging. It requires teachers to be thoughtful and deliberate about the policies, practices, and language they use to create and guide the classroom culture over time—and how those things are perceived and experienced by students. How might teachers create these environments? Here, we describe one testable model of how teachers might learn to create growth mindset classroom cultures: by developing teachers' cultural understanding of the classroom, helping them view themselves as the culture-creators of their classrooms, and by helping them place growth mindset at the center of that culture to combine effective teaching practices and activate the goals, beliefs, and behaviors associated with the growth mindset meaning system. To be clear, this model is not yet a proven method for creating growth mindset classroom cultures. Instead, it is a conceptual model, drawn from cultural psychology, that shows how ideas—such as the growth mindset—can come to shape the practices, policies, and interactions in a setting, and how those practices can, in turn, shape students' beliefs, behavior, and performance.

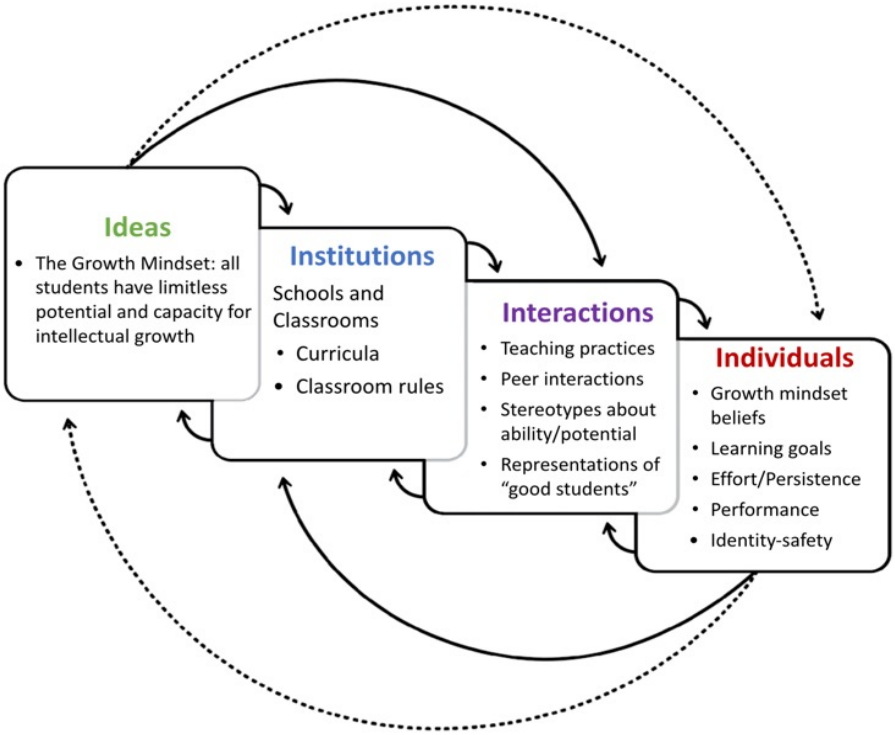
Our cultural approach makes two assumptions. The first is that if teachers are to intentionally change their classroom cultures, they must first understand their classrooms as cultural spaces; thus they must understand the various components of culture (e.g., ideas and individuals) and how these components interact to shape student experiences. The second assumption is that teachers must assume the role of culture-creators by learning to change the components they can control (e.g., their policies, practices, and interactions with students) in ways that shift the culture toward one in which growth mindset ideas are valued and supported. Below, we elaborate on a process by which teachers come to a cultural understanding of their classrooms and learn to change classroom cultures over time, using empirically-supported practices to activate the growth mindset meaning system in their classroom.

Developing a Cultural Understanding of the Classroom

How might teachers come to see their classrooms as cultural spaces and understand how the actions they take and ideas they hold shape students' beliefs and behaviors? One influential model that may help teachers understand their roles as culture creators is the *culture cycle* [17,84]. This model has been effectively adapted in teacher training to help teachers understand how the growth mindset can be used to make meaning and change their teaching practices, and how those changes in turn shape students' beliefs, motivation, and behavior (Figure 1[85,86]).

The culture cycle offers a framework that can be adapted to show how the growth mindset idea can manifest throughout classroom cultural processes to shape students' beliefs and behavior. Specifically, it describes how four levels of culture—ideas, institutions, interactions, and individuals—influence one another. This framework illustrates that cultural ideas (e.g., intelligence and ability are fixed or malleable) manifest in key societal institutions (e.g., educational systems with tracking programs that identify and provide more challenging curricula to gifted students, compared to those that provide challenging curricula to all students and support everyone's learning). Within these institutions are practices (e.g., allowing students to revise work for credit) that guide the ways individuals and groups interact. Ultimately, cultural ideas, institutions, and interactions shape individuals' experiences (e.g., students' mindset beliefs, goals, behavior, and performance).

Figure 1. The growth mindset culture cycle[85].



As an example, one component of the growth mindset meaning system is the belief that failures are not attributed to fixed low ability, but instead represent opportunities to learn. In terms of the culture cycle, this is an *idea* that teachers may want to uphold to promote growth mindset beliefs and behavior among their students. To do so, teachers could embed the idea that failure is a learning opportunity in their classroom rituals and routines (the *institutions* level). A teacher could, for example, begin each lesson by pointing out their "favorite mistake" related to the previous day's lesson or homework (see[15] for an example of this practice in a math classroom). In doing so, the teacher normalizes mistakes and uses them to deepen learning by helping students understand why certain mistakes are made and how to correct them. When students can regularly engage with and learn from mistakes, classroom *interactions* between students are also likely to shift. Instead of hiding mistakes out of fear or shame (a common practice of students who hold more fixed mindset beliefs), students may instead identify and analyze their mistakes and ask their peers to help improve their understanding. As a result, *individual* students learn that mistakes are opportunities to learn; they feel free to take intellectual risks that could result in some mistakes without fear of judgment by their instructor or peers. This culture-based understanding of mistakes reinforces students' growth mindsets by teaching them that mistakes are an indication that they have more to learn rather than an indication that they are incapable of doing well.

The culture cycle can be useful not only for analyzing the current culture of a classroom, but also for envisioning and implementing a new growth mindset culture. In other words, the culture cycle may provide a guiding framework for teachers who wish to create culture change. Because the four levels of the culture cycle are interconnected, change at any one level can create changes at other levels; however, large-scale culture change is most likely to occur when change is targeted at multiple levels[87]. As illustrated above with the "favorite mistakes" ritual, changes in everyday teaching practices (i.e., the institution/classroom level) can create meaningful changes in the classroom culture and in peer dynamics that both directly and indirectly affect individual students' mindsets and their behavioral approaches to learning (i.e., the individual level). The culture cycle can therefore help teachers to locate students' growth mindset beliefs within the broader culture and understand how "upstream" changes to their policies, practices, and daily classroom interactions can support "downstream" effects on students' mindsets and adaptive learning behaviors.

Once teachers understand the classroom as a cultural space, the next question is what *types* of upstream changes might help them create growth mindset classroom cultures. In the following section, we describe how many of the empirically supported practices reviewed above can serve as tools for teachers to create such a culture, particularly when they are combined and used flexibly with the growth mindset idea at the core.

Developing a Toolkit of Policies and Practices

Creating a growth mindset classroom culture requires policies, practices, and language that students perceive and interpret as consistent with the growth mindset idea that all students have great potential and capacity for intellectual growth. Recent research on the cues that students use to infer their teachers' mindset beliefs can help us understand which practices may foster these student perceptions[88,89].

Kroeper and colleagues[88] used focus groups of college students within the United States to develop a taxonomy of teacher practices that signal instructors' mindset beliefs to students. The researchers taught the students about the growth and fixed mindset ideas and then asked them to describe instructors who seemed to hold one of the two mindsets. Four categories of teacher practices emerged from these descriptions:

1. the value that teachers place on students' learning and development;
2. explicit messages about progress and success;
3. responses to student struggle, confusion, and poor performance, and;
4. provision of opportunities for practice and feedback.

Later quantitative studies confirmed that practices within these categories were associated with students' perceptions of their teachers' mindset beliefs. In one study with over 700 college students in the United States, students relied on these practices to predict/infer? their teachers' mindset beliefs[89].

In another study, United States undergraduates categorized more than 100 practices, policies, and behaviors as signaling instructors' growth or fixed mindset beliefs. These 100 practices fell into the four categories of teacher practices described above (e.g., explicit messages about progress and success; responses to student struggle, confusion, and poor performance), and each category significantly predicted students' perceptions of their instructors' mindset[88].

In addition, a large cross-national study surveying approximately 600,000 adolescent students in 78 countries found that students' reports of similar teacher practices were associated with students' own growth mindset beliefs[90]. Across a wide range of countries, students who reported that their teachers helped them with their learning, provided extra help to struggling students, continued teaching until students understood, and showed an interest in all students' learning were four to five percentage points more likely to report having growth mindset beliefs. This finding suggests the intriguing possibility that teaching practices that support students' growth mindsets may be consistent across many cultural contexts.

In Table 1, we take the empirically derived practices from large observational studies[88,89] (e.g., the MET, the National Center for Teacher Effectiveness (NCTE) and filter them through the growth mindset perspective. We show how each of these practices can signal a growth mindset to students and contribute to a growth mindset classroom culture. For example, one type of practice supported by teacher observation research is to create an inclusive classroom environment tuned to learning by showing students' how their varied personal and cultural experiences contribute to the learning community. When this powerful practice is combined with a teacher's intention to support the growth mindset idea that all students have great potential and capacity for growth, the practice may evolve and take new forms. The teacher may focus on challenging negative societal stereotypes about which groups are naturally gifted in school (or in a specific subject) by explicitly reaffirming that all students are capable of growth, and that students' cultural differences and backgrounds enhance learning for the entire class. By doing so, the teacher may take an already effective practice and use it to concretely create a growth mindset classroom culture that is perceived and experienced as such by students.

Table 1. *Four categories of empirically derived teacher practices that communicate a growth mindset supportive classroom culture to students.*

Growth Mindset Approach	Classroom Examples	Supporting Works
Inclusive Classroom Environments Tuned to Learning		
Inclusion. Educators communicate that all students can be successful and have a responsibility to help one another grow. Educators acknowledge students' differences (vs. colorblind teaching) and affirm that these differences will enhance learning. Educators also acknowledge negative stereotypes about ability and challenge these stereotypes by explicitly communicating that all students are capable and can make important contributions to class learning.	The teacher designs lessons so that students can engage in multiple ways (e.g., not only by voicing their ideas but also by working with a partner/group). The teacher models different ways of approaching material/different perspectives and designs lessons where students try using different approaches to the same material.	91,92
Organization and Classroom Management		
Framing. Educators introduce a lesson/activity and explicitly communicate the learning objectives, the purpose of the activity, and how the activity will help students grow. Educators convey that with time, practice, and good strategies, all students are capable of succeeding.	The teacher begins a lesson by reminding students how they will build on previous knowledge in a new unit. The teacher tells students that the lesson may be challenging, and we will make mistakes, but we are working together as a class to help each other grow.	2,80,93,94
Learning Strategies. Educators focus on the process of learning and foster perseverance by equipping students with a variety of learning strategies. Educators encourage students to seek help when they are stuck and to share their strategies with one another, try different approaches, and learn from their peers.	The teacher might display or upload to the course management system a strategy board so that when students get stuck, they can look to the board to find a different strategy to try. The teacher describes and models help-seeking as a valued classroom behavior.	77,89
Supportive Instruction and Assessment		
Responses to Struggle and Mistakes. Educators frame struggle and mistakes as a normal and necessary part of learning and encourage students to help each other through them.	The teacher chooses a "favorite mistake" that reflects a common misunderstanding, celebrates the opportunity for learning, and shows the class how to correct the mistake by choosing a different strategy.	95,96
Feedback. Feedback happens both informally in the moment and formally through assessment of student work. In growth mindset classrooms, educators give specific feedback about what students are doing correctly and incorrectly and offer different strategies to help students overcome difficulties. Feedback is presented as formative rather than strictly evaluative.	The teacher offers specific strategies that students can enact in order to improve and focuses on behaviors and choices that students can control, rather than on innate talents or skills that leave students feeling powerless.	81,97,98
Assessment. Periodic growth mindset assessment supports continued learning and engagement. Assessments focus on process and growth rather than perfect performance. Educators acknowledge the limitations of single assessments and give students multiple opportunities to demonstrate mastery using different assessment modes. Assessments include measures of growth over time, not just final performance.	The teacher checks for student comprehension at multiple points in a unit (e.g., through ungraded written or oral quizzes), and the final grade reflects both progress (i.e., improvement) and mastery of material. In other words, students are not penalized for beginning the unit with lower levels of mastery and are instead rewarded for gains made over time. The teacher encourages (and rewards) revision.	74,89

Planning and Preparation		
Pre-term Planning. Educators prepare an introduction to the course, select and prepare materials that set the tone of the course (e.g., a syllabus), and select practices and plan assessments to be used throughout the term to ensure that the norms and activities of the class support a growth mindset culture.	Prior to instruction, the educator decides to frame each lesson with a reminder that the class is taking on new challenges together so that they can grow. They might reinforce this framing by developing a progress chart to map the class's learning and progress over the course of the unit.	99
Ongoing Reflection. Educators question how their current practices do or do not orient students toward growth, progress, and mastery. Then they identify specific focal growth mindset practices and develop plans for further implementing or revising these practices and holding themselves accountable (e.g., teacher progress sheets, accountability partners, daily/weekly/monthly reminders).	Once every two weeks, the teacher sets aside time to reflect on the culture and practices in the classroom—with a specific focus on how the culture is affecting all students (especially those from structurally disadvantaged backgrounds). They identify ways to reinforce and support the class's growth mindset values and practices for the next two weeks.	100–102

Note. References in bold are empirical studies and references in plain type are supporting theoretical works. We identified four categories of practice that align with the growth mindset perspective. The practices within each category were derived from large observational studies and the empirical and theoretical studies cited here.

Agenda for Future Research

The research on teacher mindsets and teacher-focused interventions is an encouraging step toward understanding how to most efficiently and effectively harness the power of the growth mindset in education. Yet several pressing theoretical and practical questions need to be answered so that teachers, schools, and researchers can work together to build and assess the impact of growth mindset classroom cultures on students' motivation, behavior, and performance. We see at least five areas where more research is needed.

First, from a theoretical perspective, if we aim to build growth mindset cultures, we must understand how the growth mindset idea can be misconstrued (a phenomenon termed "false growth mindset") and how to correct misconceptions among teachers and administrators. Second, to create growth mindset cultures, we may need to understand the practices, policies and messages that create fixed mindset cultures, and work to help teachers eliminate and replace these potentially limiting learning environments. Third, we need to examine which practices, or combination of practices, most clearly communicate a growth mindset classroom culture to students, and how we can help teachers to implement those practices. Fourth, we need to understand how growth mindset practices may have different effects for students from different backgrounds and cultures so that we can create equitable and inclusive growth mindset cultures in school. Finally, we need to identify effective ways to intervene with teachers who bring with them different personal and professional characteristics and are teaching in different districts, regions, and countries with norms and cultures of their own. We need to understand how we can work with teachers so that they are inspired to change their teaching

practices to create growth mindset cultures that support students' learning and development.

Identifying and Shifting False Growth Mindset

A teacher-focused growth mindset intervention aims to help teachers create growth mindset cultures in their classrooms through a set of intentional, everyday practices that support students' growth mindset beliefs and behaviors. It's essential to help teachers understand the core growth mindset idea and how it relates to their practices and students' outcomes. But it may be just as important to help teachers understand what growth mindset is not. That is, we need to know how teachers misunderstand and misapply the growth mindset and how we can help them overcome such misunderstanding.

The power of a cultural approach to mindset may lie not only in the comprehensive strategy it provides for fostering, reinforcing, and sustaining growth mindsets in classrooms, but also in its ability to circumvent a known problem in the misapplication of mindset research: the "false growth mindset". As Dweck[8,9] has written, the concept of growth mindset has been met with much enthusiasm from educators and educational policymakers, given the extensive research demonstrating that growth mindsets can improve students' motivation and academic outcomes. However, as growth mindset has increasingly been integrated into teacher education and practice, it has also been oversimplified, misconstrued, and often misapplied.

One of the most common false growth mindset beliefs is that mindsets are dichotomous[8,9] —that is, people have either a fixed or a growth mindset. In reality, growth and fixed mindsets exist on a continuum, and contextual cues push people toward the growth or fixed end[103]. Without a deep understanding of how environments shape mindsets, teachers may tend to view mindsets as inherent or fixed characteristics of students. For example, in a case study of ninth-grade math teachers, some teachers perceived that students' seemingly entrenched fixed mindsets were a major obstacle to fostering a growth mindset classroom environment[104]. Indeed, this dichotomous view of mindsets is likely to increase the stigmatization of certain students (often those from negatively stereotyped groups) who are seen as "having a fixed mindset" or as "unteachable" or "lost causes"[103]. Such stigmatization has immediate negative implications for students who are labelled as "having a fixed mindset." But it also has larger implications for the persistent problem of educational inequality. Meta-analyses demonstrate that these fixed beliefs about student potential are likely to perpetuate educational inequality, because they predict greater legitimization of inequality and reduced support for policies intended to increase educational equality[105].

How can false growth mindsets be prevented? A cultural understanding of the classroom shifts the focus—as well as the blame for endorsing fixed mindset beliefs and the burden for changing these mindsets—from the students to the educational environment. A cultural approach highlights the role teachers play in helping students adopt a growth mindset and enact the positive behaviors that arise

from these beliefs. That is, teachers come to understand that by promoting growth mindset ideas through their policies and interactions, and by consistently using growth mindset supportive teaching practices, they can shape the environment and shift students toward the growth mindset.

As we work with teachers, we need more research to identify when false growth mindset practices (such as focusing exclusively on effort) arise and how they fall short of actual growth mindset practices (such as emphasizing that students can increase their ability through effective effort, good strategies, and help-seeking at the appropriate times). As growth mindset research becomes more popular, researchers need to understand and document when and why teachers misunderstand the core growth mindset idea and the potentially adverse effects that could follow. Which teacher practices communicate a false growth mindset? What effects do teachers' false growth mindsets have on student engagement, persistence, and performance? How can we avoid misapplication of the growth mindset classroom cultural approach when training teachers? By understanding how the false growth mindset shows up in teachers' beliefs and behavior, we can identify when it comes into play in the classroom and help teachers better enact true growth mindset cultures in their classrooms.

Identifying and Replacing Fixed Mindset Cultures

Which policies, practices, and messages communicate fixed mindset beliefs to students, and how might these practices undermine the growth mindset culture teachers wish to create? Removing these (often unintentional) fixed mindset practices may be just as important as implementing new practices that support growth mindset.

We also need to understand what happens to students when the classroom culture contains mixed messages (both fixed and growth mindset messages). Existing beliefs, one-off practices, and norms in a classroom can contradict one another and thereby undermine teachers' efforts to create coherent growth mindset cultures in which goals, beliefs, and behavior align. The same teacher who encourages students' persistence by telling them to say "I can't do this *yet*" instead of "I can't do this" may contradict that growth mindset message by offering only a few high-stakes assessments of student learning (e.g., giving only a final exam rather than multiple assessments of growth and learning throughout a unit; not providing opportunities for revision or points for learning from mistakes). That is, on the one hand, this teacher uses the power of "yet" to communicate that persistence is important. On the other hand, the teacher does not allow for, acknowledge, or reward student persistence when assessing mastery of new concepts. Any benefit students derive from the one-off growth mindset message is likely undone by the contradictory practices and policies.

The benefit of the cultural approach is that it makes room for both smaller-scale (e.g., the power of "yet") and larger-scale (e.g., assessment policies that account for progress and improvement in addition to final performance) growth mindset practices that work in tandem to clearly and

consistently encourage students to adopt growth mindset beliefs and behaviors. As a result, we suspect that a cultural approach to supporting students' growth mindsets will tend to be more effective than either non cultural approaches that focus on single, isolated behaviors or practices that fail to create a coherent link between the growth mindset regarding students' abilities and everyday practices and classroom interactions. Future research will need to document and understand these contradictions and how to remedy them.

Unanswered Questions about Growth Mindset Practices

Of course, there are many burning questions regarding growth mindset teacher practices. Which are the main teacher practices that create and sustain a growth mindset classroom culture? Are some practices essential and others synergistic? That is, which should all teachers learn, and which are optional?

One thing we are fairly certain of is that one-off growth mindset ideas and practices are unlikely to create a growth mindset culture. Yet these are some of the most common practices we have observed in teachers' classrooms—things like vague motivational posters on the walls or admonishments to students to "have a growth mindset." For example, before participating in a growth mindset culture building intervention[86], many elementary school teachers enthusiastically reported that they knew about growth mindset and used the concept in their classrooms. However, when asked how they integrated growth mindset into their everyday practices, many teachers pointed to a single phrase or piece of feedback that they gave to students (e.g., the power of "yet," praising student effort, or banning the word "smart"). These practices often have some link to the empirical literature on growth mindset (e.g., banning the word "smart" arises from Mueller and Dweck's[106] demonstration that intelligence praise can undermine students' academic motivation). In isolation, however, these one-off practices are unlikely to communicate a clear, consistent growth mindset culture that is perceived as such by students and that supports their own growth mindset beliefs. When teachers do not provide an integrated framework for their classroom policies, practices, and norms, students may simply see these phrases as idiosyncratic things their teachers say, disconnected from the larger idea that their teachers believe they can learn through effective effort and the use of good strategies.

As noted in the teacher behavior change paper[107], one of the barriers to changing teachers' practices is the real or perceived effort involved in implementing new practices. To create effective and long-term classroom cultural change, we need to understand which teacher practices are *high-leverage* practices; that is, practices that are more likely to have a positive impact on student thinking and behavior even though they might be more effortful or costly to implement. Overburdened teachers may be drawn to growth mindset practices, which are relatively easy to implement but have limited impact. For example, a teacher may decide to promote the growth mindset behavior of persistence in the face of challenges by telling struggling students to "keep trying." While the feedback conveys

that the teacher values persistence, it is unlikely to help students adopt a growth mindset because it is too general and does not offer students any learning strategies or a means of *effectively* exerting effort. A high-leverage version of this practice might involve developing a chart that describes several strategies students can try when they are stuck. Instead of telling struggling students to "keep trying," the teacher could invite them to "visit the strategy chart" and choose another strategy. The teacher still conveys that they value persistence, but they have created a sustainable and effective way to help students persist in the face of challenges and setbacks—one that shows that all students with support, can develop their abilities. Most of the research investigating high-leverage growth mindset practices has involved correlational studies[21,90] or experimental studies conducted in a laboratory with convenience samples of college students[76,79,88]. We need to understand which high-leverage practices and combinations of practices are essential to cultivating a growth mindset classroom culture. Ideally, research on this topic would be conducted in the field with teachers and their students and would not only assess individual student outcomes, but also how these practices change or shift students' perceptions of the classroom culture.

As we've emphasized, culture change is likely to be most effective when practices target multiple levels of the culture cycle. Yet few researchers have investigated how teacher practices synergistically create and sustain culture. We anticipate that teachers are likely to have the biggest impact on students' mindsets and behaviors with congruent classroom messages and practices that span the culture cycle (i.e., practices that target the institutional, interactions, and individual levels of the culture cycle in order to promote growth mindset ideas). For example, a teacher might promote growth mindset at the classroom level by creating a classroom charter or set of community agreements that uphold growth mindset beliefs and behaviors (e.g., "In this class, we help each other grow"; "We make sure that no one is left behind in class"). They might support these beliefs and behaviors with practices that target the interactions level, such as asking students to work together to solve challenging problems or to check in with one another to see if their classmates have questions about new material. The teacher might also provide individual growth mindset feedback to students that shows them how much they have developed their understanding during the year or praise students who help their peers learn something new. We need more research to understand the synergistic effect of practices at different levels of the culture cycle: Which practices work together to cultivate and sustain a growth mindset culture? How do students perceive practices at different levels of the culture cycle? Are practices at certain levels more high-leverage than others? We also need to understand how teachers can develop an understanding of their classroom cultures and the ways mindset beliefs are (or are not) embedded within these cultures. Using the culture cycle as an analytic tool is one possible approach, but more research is needed to understand how teachers engage with this model and what analytic approaches are most effective for teachers with differing levels of

teaching experience.

Finally, we need more research to understand how teachers can reflect on their own beliefs and how they convey these beliefs to students through their policies and practices. This process may involve teachers asking themselves questions such as: What are my beliefs about students' abilities and intelligence? When do I experience my own fixed and growth mindset? How does my mindset at any given moment affect my emotions and behavior? How do I talk about intelligence and ability with my students? What do I do to support students in developing their growth mindsets? These questions can illuminate the thought processes, concerns, and ideas that may contribute to teachers' ability to create and sustain growth mindset classroom cultures. How can teachers tell if they are, in fact, building a growth mindset culture? What are the measurable signs that their intentions translate into successful implementation?[108] Researchers should assess teachers' intentions to promote a growth mindset culture through planning and self-reflection, how practices are implemented in the classroom, and how students perceive and experience the classroom culture.

Unanswered Questions about Culturally Responsive Growth Mindset Practices

While empirical research on teaching practices points to a number of practices that are positively associated with student outcomes, much of this research has been conducted in the United States (e.g., the MET, the NCTE), which limits our knowledge about how these practices shape outcomes for students in other nations and cultures.[1] Moreover, relatively few studies have examined how teachers' practices may have differential effects for students from different backgrounds and with different educational barriers, even within a single classroom.[2] U.S. classrooms, for example, include a large number of students who are English Language Learners (ELL). These students may have peers from similar cultural backgrounds (e.g., an ELL student who recently immigrated from Mexico and a second-generation Mexican American student). Both groups may benefit from culturally responsive growth mindset practices, but the delivery of these practices may need to differ. We need to understand how teachers' practices may help create an equitable growth mindset classroom culture that supports the learning and potential of students from a wide variety of backgrounds.

Individuals' cultural contexts shape how they learn, understand, and evaluate new knowledge[111,112], and messages in the classroom may be perceived to support students' potential for growth only if they are provided in a culturally authentic way. For example, in cultures with strong caste systems, some groups may be viewed as intellectually inferior and superior, and these cultural beliefs are likely to shape the way students perceive and respond to their teachers' practices.

[1] A notable exception is the Third International Mathematics and Science Study[109] which compared videotapes of eighth-grade math instruction between the U.S., Germany, and Japan. However, the goal of the study was to compare teaching practices between lower- and higher-achieving countries, rather than to study how the same discrete practices were differentially effective in different cultures.

[2] Some research has examined how the effects of teaching practices differ for students with specialized academic needs[110], but to our knowledge, no studies have yet examined how these effects differ depending on students' cultural backgrounds.

Research on culturally relevant pedagogy and culturally responsive teaching is relevant here[64,65]. Culturally responsive teaching involves developing cultural knowledge about one's students and aligning pedagogy with their cultural frames of reference and prior knowledge to make learning more engaging and effective for all students. Culturally responsive teaching includes five essential elements: (1) developing knowledge about diverse cultures, (2) integrating content about cultural diversity into the curriculum, (3) creating classroom communities that value cultural diversity, (4) learning to communicate effectively with culturally diverse students, and (5) matching instruction to the learning styles of students from diverse backgrounds[64]. These elements encompass suggestions for specific teaching practices that overlap with several of those we reviewed above (e.g., integrating knowledge of one's students into practice, drawing connections to students' cultural experiences). But the culturally responsive teaching framework expands on the role these practices play in creating a culturally supportive environment. How might the growth mindset cultural approach integrate with and support the culturally responsive teaching framework?

Some evidence suggests that culturally relevant pedagogy and culturally responsive teaching can improve student outcomes. For example, teacher-student racial/ethnic matching can improve academic outcomes for Black students, presumably as a result of improved cultural fit between teacher and student (for a review, see[113]). Similarly, students who perceive their teachers as using culturally relevant practices experience higher achievement, stronger feelings of belonging, and greater academic motivation[114]. Using the principles of culturally responsive teaching, future research can guide our understanding of how to support a growth mindset approach to education for students from a wide range of cultural backgrounds.

For example, research could examine both how teachers can deliver growth mindset messages in culturally responsive ways (e.g., focusing on the collective vs. the individual for students from more interdependent/collectivist backgrounds) and how teachers can leverage students' cultural differences to encourage growth mindset development. In classrooms with ELL students, for example, teachers could communicate a growth mindset by acknowledging the effort and value of learning multiple languages. Similarly, in classrooms with students from diverse cultural backgrounds, including those who have immigrated to the country, teachers could promote a growth mindset by discussing the challenges and benefits of moving between cultural contexts.

We hypothesize that educators will be most successful in creating a growth mindset classroom culture if they create an inclusive, culturally responsive learning community in which students' approach to learning is guided by the growth mindset and its corresponding meaning system.

If teachers are ignorant of their students' cultural values and shared knowledge, they may fail to communicate their belief in students' abilities to learn and improve in ways that feel authentic and that resonate with students. As a result, their attempts to foster an equitable growth mindset classroom

culture for all may fail. In an equitable growth mindset classroom culture, all students would feel valued, included, respected, and supported in their learning, even (and especially) when they make mistakes. However, researchers haven't yet studied how teachers might create this type of equitable growth mindset classroom culture—one of the most important questions for improving students' psychological experiences and academic outcomes in inequitable educational systems.

Unanswered Questions about Intervening with Teachers

Teacher-focused interventions need to motivate teachers and make them eager to adopt a growth mindset cultural approach in their classrooms. For example, to succeed, such interventions may need to identify the kinds of evidence teachers use to justify fixed mindset beliefs (e.g., how they see their own successes and failures, and those of their students) and help teachers to view this evidence with a more growth-mindset-consistent perspective. Such motivational considerations will be essential in developing successful teacher-focused interventions, and these considerations are covered in more detail by Bryan et al.[107]. In addition to considering teacher motivation, when developing teacher-focused interventions, researchers may face constraints with regard to the amount of time school leaders and teachers can provide for the intervention, and the intensity of the intervention sessions. What should a teacher intervention look like? Intervention implementation questions are really about the necessary and sufficient components of effective teacher-focused interventions, which are ultimately empirical questions that need to be answered as scholars design, implement, and evaluate growth mindset culture interventions.

One set of implementation questions centers on the content and focus of teacher-focused growth mindset culture interventions. How much should we focus on changing teachers' own mindset beliefs compared to guiding them to adopt and implement growth mindset practices? It might seem plausible that teachers' practices should flow directly from their own belief system, but we know this is not always the case. Teachers regularly enact practices that are not congruent with their larger beliefs (and vice versa)[86,89]. Recent research suggests that students' perceptions of their teachers' behavior predict their perceptions of their teachers' beliefs—that is, students infer what teachers believe from what they say and do in the classroom[88,89]. But we need more research examining how teachers' self-reported beliefs, their behavior, and students' perceptions shape students' learning and performance.

Similarly, further research is needed to understand whether and how teacher interventions create a recursive cycle for teachers and students on their journey toward embracing and enacting growth mindsets. For teachers, the experience of reflecting on their classroom culture, making a deliberate effort to change this culture, and assessing their implementation and its effects on students may reinforce the growth mindset beliefs they endeavor to pass along to students. As past work has demonstrated, student-focused mindset interventions are most effective when teachers endorse growth mindset beliefs[11]. It stands to reason, therefore, that teacher-focused interventions

might similarly hinge upon the extent to which teachers internalize the messages they communicate to students. As teachers make changes to their classroom cultures, communicating to students that these changes are intended to help the class grow may provide another means of promoting growth mindsets among teachers and students alike. This practice allows teachers to model to students that they are willing to enact the changes they're encouraging students to enact (i.e., challenge seeking and risk taking are inherent in teachers' efforts to build growth mindset cultures). Both the practice of self-reflection and transparency about teachers' efforts to change their classroom cultures are potentially fruitful areas for research exploring the mechanisms of change operating in classrooms where teachers do the hard work of shifting the educational culture.

Another set of implementation questions centers on identifying likely moderators of a teacher-focused intervention. We need to understand how individual teacher characteristics may moderate the effects of teacher-focused interventions. For example, which teachers are more or less responsive to intervention? Is the intervention effective for teachers who already endorse a growth mindset? Are teachers who endorse fixed mindset beliefs as effective at implementing growth mindset practices as those who endorse growth mindset beliefs? Teachers' support networks should also be considered. Does the teacher have colleagues or other support systems in place to encourage and reinforce the intervention message?

When designing a teacher-focused intervention, researchers should also take into consideration how certain features of the cultural context may create barriers that limit the intervention's success. For example, how might macro-level cultures, beliefs, and norms interact to either support or undermine the local classroom culture? How effective are interventions when the larger cultural or policy context (e.g., the school or district) does not support the local classroom messages? How are teacher-focused interventions best tailored and adapted to the cultural context of the teacher, school, district, or country? The culture cycle model suggests that teachers and students are surrounded by the cultures, practices, policies, and norms that emanate from the school/district, region, and national levels. For instance, one can imagine that many stakeholders might resist the implementation of a teacher-focused growth mindset intervention, including school leaders contending with evaluation and standardized testing pressures or parents wanting to uphold special enrichment for their children. Likewise, some teachers have more autonomy over their curriculum, instructional changes, and classroom-based decisions; whereas other teachers are more restricted in what they can change and have less autonomy over instructional choices. This raises critical questions about the role of school/district leaders and their buy-in to the classroom culture change we propose.

At a much larger scale, how might national culture affect intervention uptake and motivation to pursue a growth mindset classroom culture? In one example, Colombia successfully implemented at the national level *Escuela Nueva,* a radical, new student-centered educational approach, which

replaced a teacher-centered instructional culture[115]. A key finding from the success of Colombia's national program was to use a bottom-up approach, using effective teachers as the key actors of change, as well as ensuring the proposed improvements were easily replicable within existing conditions. More research is needed to investigate and understand these factors in shaping teachers' ability and motivation to pursue some of the culture change work we believe will help students learn and develop.

Finally, we need to know more about when and how to intervene. Should the intervention take place at a specific time in teachers' careers, such as pre-service or in-service? Intervening with teachers early in their careers may allow the growth mindset meaning system to infiltrate the core aspects of teacher training, instead of being viewed as an add-on or fad. When it comes to in-service training, what time of the school year is best for gaining teacher buy-in and building teacher efficacy at creating growth mindset cultures? How many booster sessions are needed to sustain teacher-focused growth mindset culture intervention effects? These questions highlight the exciting and important avenues for future work that explores how to create and sustain teacher-focused interventions that support the mindset, motivation, and learning of all students.

Conclusion

Motivating teachers to cultivate growth mindset classroom cultures is a challenging task. Yet the need for engaging, motivating, and enriching classroom cultures has never been more pressing. The COVID-19 pandemic has highlighted the deep inequities and disparities that exist for students from structurally disadvantaged backgrounds and for economically developing nations. The growth mindset is a powerful idea that can shape students' beliefs, goals, and behavior, and embedding this meaning system at the core of classroom cultures is a tantalizing possibility. Yet changing classroom culture requires robust planning and frequent cyclical reassessment of practices, policies, and interactions from the perspective of the culture cycle. This can be overwhelming for teachers who are asked to implement these changes and for researchers who wish to measure, examine, and assess their effectiveness. Many unanswered questions need to be tackled before we can be confident that the growth mindset classroom culture approach will be effective for all students. It won't be easy. But when implemented properly, a growth mindset culture approach has the potential to transform students' educational experience. Classrooms with a growth mindset culture at their core could be places where all students are eager to learn; where equity gaps are closed; where students seek out challenging work and are unafraid to make mistakes; where students support one another's learning and development; and where teachers are motivated, engaged, and doing the work they love—helping students learn and develop.

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Initiative Paper 2

Designing an Intervention to Motivate Growth Mindset-Supportive Teaching Practices

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Keywords: growth mindset, behavior change, teacher training, teacher practices, interventions, motivation, education, classroom culture, inequality.

Abstract

The purpose of this paper is to outline what we believe to be promising a strategy for developing a scalable behavioral intervention to encourage teachers to adopt teaching practices that support a growth-mindset classroom culture. We first briefly review the most widely-implemented current policies and programs aimed at influencing teachers' instructional practices and consider, based on the available research, how effective those approaches are likely to be for encouraging growth mindset-supportive teaching practices. We then lay out what we believe to be the most important psychological forces currently at play, either facilitating or hindering teachers' adoption of such practices. On the basis of this analysis of existing psychological forces, and drawing ideas from the research literature in four complementary disciplines, we propose an "intervention toolkit"—candidate intervention ideas that we suggest should be considered for inclusion as components of a larger intervention. Throughout, we identify additional issues for consideration in designing the intervention and important questions for future research.

Designing an Intervention to Motivate Growth Mindset-Supportive Teaching Practices

We begin with the vision common to all of the papers in this series: A world where education is about learning and self-improvement first, and where evaluation and competition, to the extent they are necessary, are secondary. This is a world where students seek out challenges rather than avoiding them and are unafraid of failure; where students are more motivated to master important concepts and skills than to demonstrate their academic prowess; and where students focus more on supporting each other's learning than on competing with each other for top scores.

Although there are many unanswered questions about how to make this world a reality, it is clear that teachers must play an essential role. Through the policies they set, the manner in which they teach, and the ways they communicate with their students, teachers are the primary creators of classroom cultures [1]. A growth-mindset classroom culture predisposes students to focus on learning rather than on how smart they look, to attribute failure and struggle to controllable factors like effort and strategy instead of to an irredeemable lack of intelligence, and to see hard work and help-seeking as integral parts of the learning process rather than as signs that they lack "natural ability."

The benefits of a growth mindset for students' learning and achievement are clear and well documented [2], and they have been widely known among teachers and school administrators for at least a decade [3]. In large, national surveys, most teachers are enthusiastic about growth mindset [3]. Moreover, compared with many conventional programs and policies that are widely used, a growth-mindset classroom culture would likely be considerably less expensive to implement at scale and, research suggests, more effective at improving educational outcomes. So why are growth-mindset classroom cultures not already widespread?

We see two chief reasons: First, the question of how, concretely, teachers can create a classroom culture that supports growth mindset—the elements, or teaching practices, necessary to effectively and reliably foster such a culture—is more complicated and nuanced than is immediately obvious. Second, even assuming that a "recipe" of practices for creating a growth-mindset culture can be developed, it is unlikely that teachers could simply work those practices seamlessly and easily into their existing teaching routines on their own. As we discuss in detail below, teaching is a demanding and complex job. Teachers must often strike a precarious balance among competing priorities while navigating complex bureaucratic constraints and satisfying diverse constituencies. Any serious answer to the question of how we can create large-scale change in teachers' classroom practices must take these realities into account. Existing research provides no definitive roadmap for overcoming either of these critical challenges.

The first paper in this series[1] grapples with the first challenge—identifying concrete practices teachers could use to effectively and reliably foster a classroom culture that supports students' growth

mindsets. Based on an extensive and cross-disciplinary review of existing relevant research, that paper identifies a number of teaching practices that seem particularly promising. They fall into two broad categories: (1) language and communication (e.g., clearly and consistently expressing a belief in every student's potential to learn and improve, encouraging students to try multiple strategies for learning new concepts or material and guiding them to alternative strategies when they get stuck) and (2) policies (e.g., giving students opportunities to improve grades by revising work to demonstrate improvement, grading in ways that reward improvement and do not penalize students who struggle before mastering material).

Here, we address the second challenge. The purpose of this paper is to outline what we believe to be promising a strategy for developing a scalable intervention to encourage teachers to adopt teaching practices that support a growth-mindset classroom culture. Because we are still learning what teaching practices are needed to create a growth-mindset classroom culture, we focus broadly on how an intervention could help teachers find and sustain both the motivation and the means to make big changes to their classroom teaching, with a general emphasis on the kinds of growth mindset-supportive practices that Murphy and colleagues (this series) identify in their paper [1].

Our intention here is not to question or overturn existing scholarship in education reform and teacher training but rather to draw insights from that literature [4–7] and integrate those insights with ones drawn from other relevant disciplines (e.g., wise interventions [8], behavioral economics [9]) to outline the most effective intervention strategy possible .

The goal of this intervention would be to help as many students as possible reap the academic benefits of a growth mindset. Thus, scalability is a critical consideration. In particular, we consider two key dimensions relevant to scalability. First, the cost of administering the intervention must be low. That is, it must be cheap enough to administer that resource constraints do not limit the number of teachers it can reach.[1] This constraint rules out some obvious and otherwise promising approaches such as hiring expert teaching coaches to work with every teacher who participates in the intervention [10]. Clearly, the cost of doing that would be much too high.

The second key dimension is how conducive an intervention approach is to maintaining fidelity of implementation. Because even the subtle details of a well-crafted behavioral intervention are often critical, and because the cost of hiring and training in-person facilitators at scale would likely be prohibitive, we must limit ourselves to approaches that are structured enough to ensure that most or all teachers who participate will experience the intervention as intended. This constraint rules out other obvious and otherwise potentially promising candidate approaches such as identifying which teachers at a school are already effective at creating a growth-mindset classroom culture

[1]Note that this is separate from the question of how much the intervention costs to develop, which is much less important. The cost of administering the intervention is so important because it is a variable cost—that is, it increases in proportion to the scale on which the intervention is administered.

and assigning them to simply "mentor" a peer who is not currently succeeding at creating such a classroom culture. With such an unstructured approach, it would be impossible to have confidence that the growth-mindset mentor teachers had a clear understanding of what aspects of their teaching style were essential to their success in creating the growth-mindset culture, or that they would know how to coach a peer to emulate those aspects of their teaching style if they did.

An intervention that successfully promotes growth mindset-supportive teaching practices on a population scale could unlock educational successes that have long eluded millions of students. There are many reasons to be optimistic that we can achieve this goal. Yet this task will also entail significant challenges. And these challenges will be different from those inherent in fostering a growth mindset in students.

Current Approaches

Before we consider novel approaches for promoting growth mindset-supportive teaching practices, we briefly review the most widely-implemented current policies and programs aimed at influencing teachers' instructional practices and consider, based on the available research, how effective those current approaches are likely to be for encouraging growth mindset-supportive teaching practices.

Traditional Professional Development

The dominant approach to influencing teachers' classroom practices is professional development (PD). Although PD varies in both content and implementation, the prototypical example is a large workshop or seminar in which one or more experts (academics, book authors, or former teachers or school administrators) present research or offer advice about classroom practices to a large, mostly passive audience of teachers. In the U.S., 99% of public school teachers report participating in some form of PD [11]; states and districts spend between US$2,000 and US$8,000 per teacher annually on PD [12–14]. Reviews of PD's effectiveness are generally disappointing. Trials sometimes see improvements in teacher knowledge and classroom practice but commonly find no effects on student outcomes such as performance on standardized tests [15,16].

Our assessment of existing approaches is based primarily on a review of the existing literature, however a series of focus groups and qualitative interviews we have conducted with public school teachers in the U.S. aligned well with the overall picture depicted in the literature on PD. The clear consensus was that "traditional PD" is generally not beneficial. The most commonly expressed sentiment about it was that the expert speakers often have little or no firsthand experience with classroom teaching and therefore insufficient understanding of the realities of the job. They characterized PD workshops as often disconnected from the contexts in which they work, and too abstract to be useful. This aligns with the most common problematic characteristics of PD identified in

the research literature: PD generally fails to achieve meaningful change because (1) it fails to address the problems that teachers see as most important or relevant to their needs and (2) even to the extent that ideas do feel relevant to teachers' high priority needs, it fails to provide specific, concrete guidance for how teachers could implement those ideas in practice [4,7,17,18].

Although it seems clear that PD currently is mostly ineffective at promoting changes in teacher practice, we suspect that the problem is not that professional training workshops are inherently ineffective. Indeed, much of the literature in education reform and teacher training has critiqued traditional PD and articulated convincing visions of how it could be improved [4–7,17–19]. Rather, the problem with PD seems to be that its content and structure, as it is typically employed in real-world settings, does not help teachers to address the important challenges they are trying to overcome. Therefore, we believe PD workshops are still a promising format for helping teachers to learn about and apply teaching practices that support growth mindset. To work well, these workshops need to make clear how growth-mindset teaching practices will help them overcome the high-priority challenges they are actually facing in their jobs. In addition, such workshops should be complemented by concrete, practical guidance about how to implement new practices in the classroom and the ongoing structure and support for teacher to rehearse, iterate on, and fine tune the relevant practices until they work well [4,7,17,18].

Merit Pay

A second, less often used way to try to improve teachers' classroom practices involves merit pay programs. These take a variety of forms but typically consist of financial incentives tied to measures of teacher performance. Many programs tie bonuses to overall teacher ratings, which are a weighted average of measures of teachers' (value-added) contributions to student achievement, classroom observations, and other measures such as principals' ratings of teachers' professionalism. Research on merit pay has yielded mixed results, but mostly finds that such programs are ineffectual because the incentives are usually weak and the programs are difficult to sustain, and because they assume teachers know how to improve but simply lack an incentive to do so [20–22].

Some evidence suggests that merit pay programs work better in developing countries, though the behaviors that the incentive schemes aim to improve tend to be rudimentary (e.g., getting teachers to show up to school [22]). Little evidence supports the idea that merit pay—at least as it has been implemented to date—could effectively encourage the complex and nuanced constellation of teaching practices that are likely to support students' growth mindsets effectively. Note that this does not mean there is no opportunity for financial payments to play a constructive role in promoting the adoption of such teaching practices. Indeed, teachers who put in the hard work to incorporate the effective use of growth mindset language and policies into their classroom practices should be compensated for their time. We suspect that, if the same payments were framed as a token of appreciation rather than as an

incentive, financial payments could serve as a signal that the desired changes in teachers' practices are important and that teachers' time and effort in adopting them is valued.

Evaluation-and-Accountability Programs

Another type of incentive-based intervention, teacher evaluation and accountability systems, is slightly more promising (for an excellent discussion of such programs, see [23]). Teacher evaluation programs can be similar to merit-pay schemes in that they aim to change teacher behavior through financial incentives for high-performing teachers, but also sanctions, including the possibility of dismissal, for low-performing teachers. Evaluation systems differ from pure incentive-based programs in that they also provide detailed feedback to teachers about their performance, and they offer support (e.g., expert coaching) to help teachers improve.

Evidence about the effectiveness of evaluation-and-accountability programs is mixed. Some exceptional programs, which involve frequent feedback from master teachers [24] or very generous financial incentives [25], have been found to improve teacher performance. But more typical examples of this approach have produced mixed [26] or null results [27,28]

Further, although evidence suggests that evaluation-and-accountability programs can improve teacher practice under certain conditions, we have good theoretical reasons to doubt that they are well suited to encourage teaching practices that support a growth mindset. Specifically, evaluation-and-accountability systems assume a transactional understanding of teaching. They treat teachers as though they are motivated primarily by material self-interest rather than by a sincere commitment to doing their jobs well or promoting student growth and enjoyment of learning (as opposed to simply boosting test scores). Because of this, such programs might encourage teachers to game the evaluation scoring system: that is, to focus on obtaining the highest evaluation possible by devoting energy to the most superficial and easy-to-meet evaluation criteria while neglecting more substantive criteria (e.g., establishing student-centered classrooms or facilitating student sensemaking), which require more thought and effort to meet [29–31]. Almost certainly, the changes to classroom practices, policies, and language needed to support a growth-mindset classroom culture represent the sort of substantive practices that evaluation-and-accountability schemes generally do not motivate effectively [1]. Therefore, we do not believe that such schemes are a promising approach for our purpose.

Teacher Coaching and Professional Learning Communities

Recently, new evidence has shown that teacher coaching can have large positive effects [10]. This approach involves observation and feedback cycles between an individual teacher and a coach. On average across programs, coaching improves teacher practice by 0.5 standard deviations (SD), which is a rather impressive effect size for changes in real-world behavior. Improvements in teacher practice are defined as progress toward practice goals the coach and the teacher set together. Common examples of such goals include differentiating instruction, cultivating a supportive classroom culture,

and improving instructional delivery, time management, and classroom organization. In addition to its effects on teacher practice, coaching has been found to boost student test scores by an average of 0.2 SD—a smaller effect than that on teacher practice but one that, arguably, is more impressive when considering how difficult student test scores are to improve. These effects rival those of the most effective educational interventions ever tested, with the exception of high-dosage, one-on-one tutoring with students [32]. Most (but not all) of the causal evidence that coaching is effective, however, comes from the U.S., so the generality of these findings remains an open question.

Teacher coaching shows substantial promise as a way to foster the sort of nuanced and wide-ranging shifts in teacher practice that could support students' growth mindsets. Unfortunately, coaching is so costly to implement that, as noted above, it is not a realistic option for achieving population-scale change in classroom practice.

Some evidence suggests, however, that lower-cost variations on the coaching model can be effective—for example, teachers collaborating with one another—either one-on-one [33,34] or as part of larger professional learning communities (PLCs [35]), to identify and improve specific areas of practice. We believe such collaborative peer networks could be a valuable complement to a more structured core intervention, possibly helping teachers to refine and sustain their growth-mindset practices following the initial workshop(s) in which they learn about those practices.

One clear conclusion in the research literature on teacher training is that there is often too little practical, on-the-ground training to help teachers enact the relatively abstract principles and ideas they learn about in training programs and workshops [4,4,6,19]. PLCs could meet that need by providing a supportive group setting in which to fine tune new practices, receive feedback from colleagues, and rehearse until they have mastered them [6,36,37]. One important caveat is that PLCs would need to be provided with clear and comprehensive guidance about the details of implementation, common pitfalls to avoid, and clear instructions for PLC members about what to focus on when observing and providing feedback to fellow group members. Research will be needed to determine what specific types of guidance and structure are needed to maintain fidelity to the intervention's intended messages and goals.

Our Process and Philosophy

At first glance, it might not be clear why it is not easy to develop an intervention to foster growth mindset-supportive classroom practices by teachers. After all, the recent National Study of Learning Mindsets and the empirical research it was based on [38,39] show that behavioral scientists have become quite adept at developing interventions to teach students a growth mindset, with reliable and relatively enduring effects on behavior. Could we just make some modifications to those effective

student-facing interventions and deliver them to teachers? Almost certainly not. Such an approach would ignore the fact that students and teachers are in very different roles and are subject to different contextual factors (e.g., constraints or expectations), many of which have important implications for how an intervention is likely to be experienced.

Consider the following example: To students who routinely face academic challenges and worry about what those difficulties imply about their intelligence, a compelling and relatable growth mindset message may come as welcome news. It can release them from the upsetting idea that they are doomed to a life of low ability and achievement. But to teachers, the implications of a growth mindset are potentially more fraught. For example, the revelation that struggling or low-achieving students can succeed with enough effort, good strategies, and appropriate mentoring and support from their teachers could be understood to imply that teachers—who already are often asked to do too much with too few resources—are solely responsible for bringing struggling students' educational outcomes up to the level of their high-achieving peers. Worse still, a growth mindset message directed at teachers could be understood to imply that teachers are to blame for any struggles that past students have failed to overcome.

The point of this example is not to diminish the enormous skill and careful attention to detail needed to develop an effective, student-facing growth-mindset intervention, or to imply that teachers are likely to oppose efforts to encourage growth mindset-supportive teaching practices. Rather, we wish to illustrate a more general truth: Interventions do not take place in a vacuum. They interact with the perspectives of the people who receive them and with the contexts in which they are applied. Interventions that are highly effective in one group or situation might be counterproductive in another. Effective interventions must be carefully tailored to the characteristics of the populations and contexts in which they will be applied [8,40,41].

This important truth helps clarify why many of the current approaches to influencing teaching practices we reviewed above have yielded disappointing results: Many of those approaches have been predicated on assumptions about teachers and the context in which they do their work that either ignore or discount teachers' needs, values, and subjective experiences.[2] Instead, they have tended to focus on teachers' deficits—on what teachers lack that prevents them from being more successful: "teachers need training in new teaching methods so they can teach more effectively," "teachers need more motivation so they will try harder." These defecit-focused ideas fail to recognize and capitalize on the sincere devotion to students' success that drives so many teachers in their work [42].

Here, we employ a paradigm rooted in Kurt Lewin's field theory [43]. The most radical way this paradigm diverges from the conventional one is its fierce subjectivism. A core tenet of field theory

[2] Indeed, the most obvious exception to this rule, among the approaches reviewed above, is coaching (construed broadly to include PLCs), which is—not coincidentally, we would argue—the one class of existing approaches that appears to be quite effective.

is that any attempt to change behavior should be predicated on a comprehensive analysis of the "forces" acting on that behavior: the features of (1) the people whose behavior you seek to change and (2) the relevant context, as it is experienced by those people. Forces fall into two broad categories: "impelling forces" (referred to hereafter with the less esoteric term "propelling forces"), whose effect is to encourage the desired change, and "restraining forces," which act as barriers to the desired change. Together, propelling and restraining forces produce what Lewin referred to as a "tension system," which settles at an equilibrium point representing the likelihood or frequency of the desired behavior under the status quo [43].

The explicit consideration of restraining forces is one important way that the Lewin field theory paradigm helps us to improve on existing approaches. That is, whereas conventional approaches[3] have tended to focus on teachers' deficits, an analysis of propelling and (especially) restraining forces ensures that we consider not only what forces we might need to add to the context (e.g., new sources of motivation) to more effectively stimulate the desired behavior, but also what forces might already be present in the context and preventing teachers from enacting the desired behavior (e.g., the fact that teachers' time and attention are already spread thin by the existing demands of the job).

One reason to avoid a deficit-focused approach is fairness. When we approach the problem of how to improve classroom instructional practice by asking what teachers lack (i.e., what forces need to be added), we implicitly assume that teachers are to blame for the problems with the status quo [44]. But the analysis of propelling and restraining forces also has an important practical benefit: every restraining force we identify is an opportunity to move the needle that a purely deficit-focused approach would miss. The two most popular existing approaches, for example—traditional PD and merit pay—as they are currently employed, aim simply to add propelling forces (albeit, perhaps, not the ideal ones). They seek to improve learning outcomes by offering teachers either new, supposedly more effective teaching practices (traditional PD) or an incentive to teach well (merit pay). But these approaches do not consider the possibility that existing demands and constraints on teachers pose important barriers to the desired change and that the addition of new propelling forces is unlikely to make any difference unless those barriers are overcome.

In contrast with the deficit-focused approach, we begin with the premise that most teachers are competent professionals who are deeply committed to helping their students to succeed academically. But they also face restraining forces, including unreasonable demands placed on their time, insufficient resources and administrative support, and policy directives that interfere with their teaching goals [5]. In sum, the primary problem, at least in nations that have invested in professional training and certification of teachers, does not seem to be that teachers lack motivation or basic competence. This is not to say that there is no benefit to offering teachers new sources of inspiration

[3]We wish to make clear that when we refer to "conventional approaches," we are referring to education policy, not to scholarship about teacher training or education reform. Indeed, we draw heavily on insights from the latter body of work.

and motivation for their work or training them in new techniques. Rather, any successful effort to improve educational outcomes by changing teachers' classroom practices must also address the restraining forces that make it difficult for teachers to invest more time and energy in teaching or to experiment with new practices. We acknowledge that in some nations in the global South there can be more fundamental problems, in that teachers often receive no training and have low motivation and high absenteeism[49]; in these settings, basic competence and motivation will need to be addressed simultaneously.

Building the Foundation for an Effective Intervention

Our review of the published research literature, and our experience developing prototype teacher interventions over the last two years, has led us to identify propelling and restraining forces in three categories:

1. forces related to the nature of the teaching profession;
2. forces specific to the goal of motivating support for students' growth mindsets, and;
3. forces common to almost any effort to change adults' behavior.

In what follows, we discuss the propelling and restraining forces in each of these categories.

Many of these forces likely apply only to a subset of teachers. In some cases, a force might be relevant primarily to teachers who themselves endorse a more fixed mindset and/or are skeptical of a growth mindset. In other cases, a force may affect a set of teachers no matter the mindset they hold. For example, one common restraining force is the need for teachers to adhere to policy directives that can interfere with their pedagogical goals. This restraining force would apply to all teachers working in a system that had such policies.

It is important to clarify that our analysis of propelling and restraining forces is not intended as an assertion of empirical fact. Rather it is intended as a theoretical sketch of the major psychological forces currently shaping the classroom practices we seek to promote with an intervention. This theoretical sketch is meant to serve as the conceptual foundation for that intervention. Identifying the key propelling and restraining forces acting on growth mindset-supportive teaching practices will help to direct our search for promising intervention components toward ones that are expected either to (a) reduce or eliminate the restraining forces or (b) enhance or complement the propelling forces. Tailoring an intervention in such a precise manner is what makes it possible to produce what often seem like surprisingly large and enduring effects on behavior with interventions that are relatively low cost to administer and scale.

Forces Related to the Nature of the Teaching Profession

Propelling forces. One potent propelling force that arises from the nature of the teaching

profession is that most teachers seem to have a sincere desire to help students to learn and succeed. Although this is not surprising, it bears mentioning in part because conventional approaches to teacher behavior change fail to capitalize on it.

One factor that may contribute to this professional devotion is the iconic cultural narrative, depicted in popular books and movies, of the heroic teacher who transforms students' lives by inspiring a love of learning (for example, To Sir, with Love; Thank You, Mr. Falkner; Dangerous Minds; Dead Poets Society). We suspect that this archetype is a source of inspiration to many teachers in relevant cultures, who aspire to fulfill that transformational role in the lives of their own students.

It should be noted, however teaching is not a well-respected or highly desired profession in many parts of the world—especially in developing countries. In fact, teaching has even been called a "profession of last resort" in some contexts [49]. In contexts where this is true, we would not expect a sincere dedication to helping students learn to be a very strong propelling force.

Restraining forces. We identified three restraining forces related to the nature of the teaching profession. First, teaching—especially at the middle- and high-school level—is a complex, demanding, and multifaceted job. The educational achievement goals that are the central focus of education policy constitute only one of a wide and varied range of priorities that teachers are expected to satisfy simultaneously. In addition to teaching their students effectively, for example, teachers—especially teachers of adolescents—are expected to maintain discipline in a group of students going through a notoriously rebellious phase of life, to provide emotional support to students suffering from personal crises or mental health challenges, to serve as a school's primary liaison to parents, and to complete a large volume of bureaucratic paperwork. With so much on their plates, teachers may perceive suggestions for changes in their teaching practices as irrelevant or overwhelming [4,17]. This force exerts a strong restraining effect on any effort to change teachers' classroom practices.

Second, in most of the developed world, teachers are professionals who had to complete years of training. In addition to their formal training, most teachers have also had to spend years, after starting their jobs, figuring out ways to implement their training effectively in the classroom [4,5]. As a result, teachers' expertise about, and comfort with, the daily practice of their jobs is often hard won and any suggestions from researchers about how they might make changes to that daily practice should be presented in a way that honors that expertise, or they risk being (correctly) seen as disrespectful of teachers' professionalism. Teachers in the global South, who typically are given very little formal training, may face an even tougher predicament. Their teaching practices are often self-taught and developed, at least in part, as a way to survive in the badly under-resourced context in which they teach. Therefore, these teachers may be even more reluctant to make changes to a set of practices that they have depended on to at least "get by" in their role.

Third, teachers have good reason to be skeptical of popular new trends. For decades now,

promising new educational ideas from research (e.g., boosting self-esteem or adapting to different learning styles) have been prematurely touted as the solution to longstanding challenges and implemented on a large scale, only to produce disappointing results and be abandoned—a problem known as the "education hype cycle" [50]. Some of those failed movements were based on ideas that had genuine merit but were applied before they were understood well enough to be implemented effectively. As a result, many teachers have become jaded about trendy new ideas from research.

Forces Specific to the Goal of Motivating Support for Students' Growth Mindsets

Propelling forces. We identified two major propelling forces specifically related to the goal of motivating support for students' growth mindset. First, as we note above, most teachers are already motivated to help students succeed. Therefore, to the degree that teachers view growth mindset-supportive teaching practices as an effective way to achieve this goal, they are likely to want to implement them. Second, a growth mindset-supportive approach to teaching may be appealing because of what it implies about teachers' potential to help their struggling or difficult-to-reach students. The belief that all students are capable of learning and improvement is central to a growth mindset, and this perspective may be seen as a source of hope for teachers trying to get through to struggling or disengaged students.

Restraining forces. Five primary restraining forces are related to the goal of motivating teachers to support students' growth mindsets.

Three of them involve concerns that supporting students' growth mindset will impose additional burdens on teachers.

First, because the growth mindset implies that all students are capable of learning and improving, some teachers may worry that, by endorsing it, they are accepting full responsibility for their students' progress (or lack thereof). Some teachers might worry, for example, that a growth mindset, by implication, burdens them with all the responsibility for ensuring that even their most disengaged or difficult-to-reach students succeed.

Second, supporting the growth mindset requires that teachers repeatedly and consistently implement a particular set of practices [1] because short-term changes are likely insufficient to create a new classroom culture. The idea of applying a new set of practices consistently may be overwhelming for some teachers.

Third, and closely related, supporting students' growth mindsets requires more than the rote application of a few discrete practices. Full support for students' growth mindsets requires that teachers learn and apply a constellation of practices in a manner that is flexible and that responds to a wide range of circumstances and student needs [1]. Teachers' worries about whether they have the time to devote to learning these skills might have a powerful effect on whether they adopt these practices.

The other two restraining forces in this category are related to conflicts between a growth

mindset-oriented approach to teaching and some teachers' own views of education.

Fourth, teachers may have quite different views of the role they should play in the education process. Teachers who hold more of a fixed mindset, in particular, might see their role primarily as the sorting of students into ability groups. Although this practice may simply be intended to individualize teaching to students' ability levels, it entails a belief that some students cannot learn at a high level. To these teachers, a growth mindset-supportive approach may seem to deny that students are currently at different skill levels, and perhaps to deny their belief that these differences are deeply rooted and unlikely to change.

Fifth, in many cases teachers may believe that their job is to convey the material and that the students' job is to learn it. To such teachers, the levels of emotional support and encouragement needed to create a growth mindset-supportive classroom culture might feel like unnecessary coddling that is inconsistent with values such as personal responsibility or self-reliance.

Forces Common to Most Efforts to Change Adult Behavior

Propelling forces. One important propelling force is related to the nature of adult behavior change in general. A great deal of research indicates that people often highly value the respect and admiration of their peers or other social reference groups [51,52]. Therefore, if we can credibly frame a teaching practices that support growth mindset as a means of heightening that respect, we may be able to strongly motivate people to adopt it [53–56].

Restraining forces. We see two primary restraining forces that are common to most attempts to change adult behavior and seem relevant to our goal. First, one of the most thoroughly documented phenomena in behavioral science is people's pervasive tendency to overvalue outcomes in the immediate term and undervalue outcomes in the future—a phenomenon known as myopia or "intertemporal discounting" [57–59]. Growth mindset-supportive teaching practices require a substantial immediate investment of scarce resources (time and effort) in service of an uncertain but hoped-for reward in the future: more student success. For this reason, teachers might be reluctant to invest the time and energy to develop a new set of skills for an uncertain benefit in the future.

Second, existing practices and habits tend to produce inertia [60–62]. Even if an intervention inspires a teacher to adopt a new growth mindset-supportive approach, the immediate effect is simply an *intention* to do so. The gap between forming an intention to change behavior and actually changing the behavior is often considerable (see a discussion of this issue by Trzesniewski and colleagues in this series [63]). Unless the intervention strategy includes elements to help them realize that intention, teachers might simply continue with their habitual practices.

Assembling an Intervention Toolkit

By mapping out the propelling and restraining forces acting on the behavior we seek to change, we create a concrete framework to assess whether a candidate intervention component is likely to move behavior in the desired direction. To generate intervention ideas, we have drawn from four complementary perspectives on the behavior-change challenge before us: social psychology and "wise interventions," behavioral economics and "nudges," education policy research, and user-centered design (see Table 1). The intervention ideas we propose in this section are meant to be considered as potential components of a larger intervention that combines some or all of these ideas into a coherent whole. The question of how well each of these proposed components will work in combination with the others will be an important one for future research.

Social Psychology and "Wise Interventions"

Although relatively new as a defined approach for addressing social and policy challenges, wise interventions have their roots in the classic social psychology of the early to mid-twentieth century [43,64–66]. Wise interventions aim to change behavior by altering how people make sense of themselves and their circumstances [8]. Indeed, the student-facing growth-mindset intervention is an example of the wise-interventions approach: by teaching students that their intelligence (and other abilities) can grow as they take on difficult challenges, this intervention transforms the meaning students make of the struggles they encounter in school. A growth mindset helps students see experiences of struggle and perseverance as signs that they are strengthening their intellectual abilities and developing valuable new skills, rather than as signs that they simply do not have what it takes to succeed. This more optimistic (and more accurate, particularly in a classroom with a growth mindset culture) understanding of academic difficulty and struggle fosters a host of beneficial changes in students' behavior, including greater enthusiasm for taking on challenges, greater perseverance in the face of difficulty, and more willingness to seek help when they need it [2,67].

One strength of values alignment is that it often simultaneously adds powerful propelling forces and removes restraining forces. To understand how, consider a specific example: a pilot intervention that used values alignment to encourage high school teachers in the U.S. state of Texas to express explicit support for a growth mindset to their students [69].

This pilot intervention was built around a core value that the researchers identified in collaboration with several teachers from the target population (see "Enlisting teachers as co-creators of the intervention," below): the ability to capture the respectful and engaged attention of a classroom full of students without coercion or threats.[4] All of the teachers who collaborated with the researchers

[4] We have found, by conducting many such collaborative design processes across a wide range of populations and contexts, that asking people to think of one member of their group that they and others "really respect and admire" and then to "tell us a story about why [they] and others really respect and admire that person" is an effective way to begin to identify core values in that group.

Table 1. *Potential intervention components, the restraining forces they are designed to address, the propelling forces they are designed to create, and the mechanisms by which they might accomplish those goals. 6 x 8*

Source Discipline	Intervention Feature	Restraining Forces Addressed by Intervention Feature	Propelling Forces Created by Intervention Feature	How Intervention Feature Could Address Restraining Forces	How Intervention Feature Could Create Relevant Propelling Forces
Wise interventions	Values alignment	(1) Teaching is a demanding, complex, multifaceted job requiring a nuanced process of balancing priorities (2) Growth mindset might be seen as inconsistent with self-reliance and/or toughness values	(1) Motivation to master the skill of engaging students and thereby gain respect/admiration of colleagues	(1) By clarifying how growth mindset-supportive teaching practices can help prevent student disengagement and facilitate re-engagement of already-disengaged students thus reducing the need to spend time and energy on classroom discipline. (2) By emphasizing that high expectations for students' effort are a central part of growth mindset-supportive teaching	(1) By making clear how growth mindset-supportive teaching practices can help teachers to inspire respectful engagement from their students
Behavioral economics and "nudges"	Defaults	(1) Teaching is a demanding, complex, multifaceted job requiring a nuanced process of balancing priorities (2) Inertia can stand in the way of translating intentions into actual changes in behavior ("intention-action gap")	N/A	(1) By reducing the time and effort required to implement new growth mindset-supportive practices (2) By reducing the need for teachers to remember to initiate the implementation of new growth mindset-supportive practices themselves	N/A
		(1) Teaching is a demanding, complex, multifaceted job requiring a nuanced process of balancing priorities (2) Inertia can stand in the way of translating intentions into actual changes in behavior ("intention-action gap")	N/A	(1) By reducing the need for teachers to remember to initiate the implementation of new growth mindset-supportive practices themselves (2) By reducing the need for teachers to remember to initiate the implementation of new growth mindset-supportive practices themselves	N/A

Source Discipline	Intervention Feature	Restraining Forces Addressed by Intervention Feature	Propelling Forces Created by Intervention Feature	How Intervention Feature Could Address Restraining Forces	How Intervention Feature Could Create Relevant Propelling Forces
	Timely reminders	(1) Teaching is a demanding, complex, multifaceted job requiring a nuanced process of balancing priorities (2) Inertia can stand in the way of translating intentions into actual changes in behavior ("intention-action gap")	N/A	(1) By reducing the need for teachers to remember to initiate the implementation of new growth mindset-supportive practices themselves (2) By reducing the need for teachers to remember to initiate the implementation of new growth mindset-supportive practices themselves	N/A
	Regular feedback	(1) Teaching is a demanding, complex, multifaceted job requiring a nuanced process of balancing priorities (2) Inertia can stand in the way of translating intentions into actual changes in behavior ("intention-action gap") (3) Support for students' growth mindsets requires a complex constellation of practices, applied flexibly, and customized to their students and their subject area	N/A	(1) By reducing the need for teachers to remember to initiate the implementation of new growth mindset-supportive practices themselves (2) By reducing the need for teachers to remember to initiate the implementation of new growth mindset-supportive practices themselves (3) By helping to calibrate teachers' judgment about whether their efforts to create a growth mindset-supportive classroom culture are succeeding from the perspective of their students, allowing them to fine tune until student feedback indicates they have found a successful formula	N/A
Educational policy research	Professional learning communities	(1) Teaching is a demanding, complex, multifaceted job requiring a nuanced process of balancing priorities (2) Inertia can stand in the way of translating intentions into actual changes in behavior ("intention-action gap")	(1) Social support through the inevitable struggles of making changes to one's teaching (2) Social accountability for maintaining changes to practice over time (3) Opportunities to rehearse, receive feedback, and fine-tune practices before implementing them in the classroom	(1) By providing a forum for teachers to receive peer social support as they work to implement new growth mindset-supportive teaching practices (2) By providing peer accountability to help teachers stay on track as they work to implement new growth mindset-supportive teaching practices	(1) By organizing a group of professionals around the shared goal of implementing new practices (2) This is a natural consequence of having shared goals and regular meetings to discuss progress (3) This is the avowed purpose of organizing these groups and holding regular meetings

Source Discipline	Intervention Feature	Restraining Forces Addressed by Intervention Feature	Propelling Forces Created by Intervention Feature	How Intervention Feature Could Address Restraining Forces	How Intervention Feature Could Create Relevant Propelling Forces
User-centered design	Enlist teachers as co-creators of intervention	(1) Teaching is a demanding, complex, multifaceted job requiring a nuanced process of balancing priorities (2) External suggestions for teachers to change their practices may be perceived as insulting or disrespectful to their expertise and professionalism	N/A	(1) By helping to ensure that the intervention is designed in a manner that is sensitive to the needs of, and constraints on, teachers (2) Allows the intervention designers to show respect for teachers' expertise by making clear to participants that the intervention was designed in collaboration with teachers	N/A
	Include collaborative customization component in intervention	(1) Teaching is a demanding, complex, multifaceted job requiring a nuanced process of balancing priorities (2) External suggestions for teachers to change their practices may be perceived as insulting or disrespectful to their expertise and professionalism	N/A	(1) By maximizing the flexibility of how growth mindset-supportive practices can be implemented, allowing them to fit more comfortably with each teacher's personal teaching style (2) By honoring participating teachers' expertise	N/A

agreed that teachers who possess this ability inspire admiration from their colleagues.

The researchers then designed an intervention that framed the clear and explicit expression of their belief in every student's potential to learn and improve as a means to master the skill of engaging students. The intervention's logic was predicated on explaining recent advances in developmental science, which have revealed that adolescents are hypersensitive to cues about whether they are being treated with respect by others [70]. When adolescents feel that their teacher respects them, they tend to reciprocate by giving the teacher their respectful and engaged attention. By contrast, when adolescents feel disrespected by their teachers, they tend to withdraw, behave disruptively, or otherwise disengage. The intervention further explained that a teacher's belief in every student's potential to learn and improve academically is critical to maintaining a mutually respectful student-teacher relationship. That is, if students suspect that their teacher does not believe they have the potential to learn and improve academically, they are likely to conclude that the teacher has written them off.

As we said earlier, one of the important forces that likely restrains teachers from adopting more growth mindset-supportive teaching practices is the wide variety expectations they are already expected to meet, including the responsibility to maintain discipline among students in an age group that is notorious for its rebelliousness. By articulating how growth mindset-supportive practices could help teachers to maintain discipline without coercion or threats, the values-aligned framing was designed to attenuate this restraining force.

A second restraining force we identified was the perception among some teachers that support for students' growth mindsets constitutes unreasonable coddling and is inconsistent with important values like self-reliance and personal responsibility. The intervention was designed to reduce this restraining force (and possibly even turn it into a propelling force) by emphasizing that a key element of supporting growth mindset is communicating the expectation that every student will "put in the hard work" to learn and improve, while also making clear that the teacher will be there to support any student who puts in that effort. That is, by using language that subtly emphasized the compatibility between a growth mindset and the value of hard work and student agency in learning, the intervention aimed to reduce the effect of a restraining force that may be especially prevalent among teachers who are skeptical of the growth mindset.

Evidence from initial randomized, controlled tests of this values-alignment intervention indicates that it effectively fosters enthusiasm among teachers for implementing growth mindset-supportive practices in their own classrooms. Teachers who received this values-alignment intervention, for example, were more likely than teachers who received a control intervention to report that they intended to express regular support for growth mindset in their classes—an important first step to behavior change. Perhaps most promising of all, the values-alignment intervention was

especially effective among teachers who held more of a fixed mindset before they completed the intervention.

Thus, values alignment appears to be a promising tool for neutralizing or possibly even reversing the restraining forces that prevent teachers from adopting teaching practices that support growth mindset. At the same time, it can engender a powerful new motivation (propelling force) for adopting such practices. Future research should examine how broadly the respect-focused values-alignment framing used in this pilot intervention can be applied to other populations of teachers and other cultural contexts—but also how growth mindset-supportive teaching practices can be aligned with other core values that teachers in various contexts share.

Behavioral Economics and Nudges

Nudges are small interventions designed to encourage particular behaviors or choices by reducing or eliminating psychological obstacles [9]. The idea behind nudges is that people are more likely to adopt a desired behavior if the context makes it easy to do so[5]. Even if an intervention successfully motivates teachers to change, teachers might fail to put the intended changes into practice because of small but important psychological obstacles. We identified two such obstacles in our analysis of restraining forces: (1) the often-overwhelming demands teachers are already expected to meet, which could make it difficult to implement any practice that requires much time and effort to implement[6], and (2) the inertia that results from people's heavy reliance on routines and habits to guide their everyday behavior choices.

Some classroom policies that are designed to support students' growth mindset, such as offering students the opportunity to improve their grade on an assignment by revising it, require substantial work from the teacher up front before they can be put in place. The prospect of rethinking the grading and evaluation system might be overwhelming. One way to reduce the need for significant upfront investments of scarce time and attention—and thus make it easier for them to adopt complex policies—is to give teachers *self-contained template***s** in which all of the details have already been worked out, though teachers should still be able customize them [72].

Similarly, a promising way to overcome the inertia that often prevents people from following through on intended changes in behavior is to prompt teachers, before they complete the intervention session, to create detailed *implementation plans* that spell out how they will enact intended changes in practice [73,74]. Extensive research has shown that such implementation plans can help people overcome inertia and translate intentions into action. To be effective, such a plan should specify the

[5]Making a behavior choice "easy" refers to different psychological phenomena in different contexts. For example, it might mean being reminded of an important to-do item at just the moment when one needs to act on it[71]. In other contexts, it might mean setting defaults 60 such that one does not even need to think about the choice at all.

precise conditions that will prompt a teacher to implement the new behavior. For example, "The next time I notice that one of my students is struggling to understand a concept, I will try a different way of explaining it rather than simply moving on."[7] Implementation plans help overcome inertia by designating a contextual cue (in our example, "the next time I notice that one of my students is struggling to understand a concept"), which then triggers the intended behavior.

Another common nudge that can help bridge the gap between intentions and actual changes in practice is the *timely reminder* [75,76]. For example, a teacher might intend to deliver a short speech to students at certain critical moments; for example, to remind them that she believes in every student's ability to learn and improve, or to offer support to students who are struggling to meet her high expectations. If teachers are encouraged to set calendar alerts or smartphone reminders to go off when they anticipate that a reminder will be helpful, they may override their habitual routine and deliver the speech as intended. Such reminders could be employed for new practices until they have been repeated enough times that they become habitual.

A fourth type of nudge is *regular feedback* [77–79] to teachers about students' experiences. Feedback may help teachers to sustain growth mindset-supportive classroom practices and improve their effectiveness over time. Students could be surveyed regularly to assess their perception of whether the classroom culture supports a growth mindset (e.g., students might be asked to rate their level of agreement with statements like "My teacher believes that everybody in my class can be good at math"), and the teacher would receive the aggregated results of those surveys. Such regular feedback would remind teachers of their goal of creating a classroom culture that supports growth mindset and possibly also serve a social accountability function if teachers expected to discuss the survey results with colleagues, for example, in a PLC meeting. It would also help teachers judge whether they are effectively communicating their support for growth mindset and to adjust their practices until student feedback indicated that they were having the intended effect.

Ideas Drawn from Education Policy Research

Professional learning communities (PLCs), which are described above in our review of existing approaches [35,37] seem to us a promising way to provide ongoing support and guidance to teachers as they work to implement new practices in their classrooms. PLCs have a number of potential benefits: they provide a forum for teachers to rehearse, receive feedback on, and fine-tune new practices before trying them in the classroom, peer accountability for maintaining changes over the long term,

[7]The point, here, is not that teachers are averse to expending time and effort but rather that, in many cases, all of a teacher's available time and effort is already being devoted to existing responsibilities so devoting *any* time and effort to something new requires a tradeoff.

[7]One clear deficit in teacher training that has been identified in the literature is the lack of practice-based training [4–6]. As a result, many teachers may simply not feel competent to try different ways of explaining a concept. For this approach to be effective, therefore, it might be necessary to provide complementary training to teachers in

and social support they can rely on through the inevitable struggles that come with making changes to a complex system of practices like classroom teaching. To ensure that group discussions remain consistent with the content and intended goals of the intervention, groups should be provided with clear and comprehensive guidance about how they do their work, including detailed instructions, model examples of how a practice should be implemented (e.g., video recordings of teachers demonstrating the relevant practice, example syllabi or scripts, etc), equally detailed instructions for providing feedback to colleagues when they rehearse a practice, and even explicit prescriptions for group norms and common language to be used when talking about certain key concepts, challenges, and practices.

Ideas Drawn from User-Centered Design

User-centered design is a set of protocols and tools for designing interventions, products, or experiences that are attuned to the perspectives, needs, and goals of the intended user. There are many ways to gain an understanding of the participant's perspectives, needs, and goals; we rely on our analysis of the tension system in which teachers' growth mindset-supportive practices are embedded.

Enlisting teachers as co-creators of the intervention. Among the most powerful restraining forces we identified were (1) the often-overwhelming number and variety of different expectations that teachers are expected to meet (educational goals, discipline, paperwork, etc.); and (2) the risk that researchers or other outsiders who make suggestions about how teachers could do their jobs differently might be seen as not fully understanding or respecting teachers' expertise and professionalism.

One way to counter these restraining forces is to include teachers in the intervention design process from the beginning. For example, researchers might begin with a preliminary idea, rooted in theory, for an effective intervention approach. Then they might conduct a design-and-adjust cycle based on feedback and suggestions from the teacher co-designers until all agree that the resulting design is appropriately attuned to the relevant considerations. Indeed, this approach was central to the design of the respect-focused values-alignment pilot intervention described above (see Values alignment, above) [69]. The researchers consulted with teachers in the target population to identify and clarify powerful approaches for the intervention. For instance, the researchers consulted with teachers to identify a key core value in the population. The researchers then developed arguments that credibly framed expressions of support for a growth mindset as a means to enact and attain this core value. These arguments were further refined in consultation with teachers to make sure they were compelling and likely to resonate with other teachers.

An additional benefit of enlisting teachers to help create the intervention is that they can offer rich descriptions of how they might implement the suggested changes in their own classroom, and

what the benefits of those changes might be. Quotes from the teachers can then be integrated into the content of the intervention itself. Such quotes may help other teachers see how integrating these changes might be both feasible and beneficial. They may also communicate that other effective teachers have found the suggested practices to be helpful. Indeed, quotes and descriptions from interviews with teachers were key components of the values-alignment pilot intervention with high-school teachers in Texas and are a mainstay in effective wise interventions in general [8,40].

Importantly, because this process occurs at the intervention *design* stage (i.e., teacher co-creators have a hand in the initial design of the intervention message and materials), it makes it possible to involve teachers in shaping the intervention experience without adding cost or complexity at the implementation stage (where, as we noted above, cost is a critical consideration).

Including a collaborative customization element. Another important restraining force we identified was the complex skillset that teachers need to flexibly implement to create a growth mindset-supportive classroom culture.

One approach to overcome that restraining force is to offer opportunities for collaborative customization. That is, rather than developing a scripted, "teacher-proofed" intervention that simply tells teachers how they should change their classroom practices, teachers can be invited as collaborators to construct and implement the changes in practice. For example, at a minimum, once teachers are introduced to a set of practices, they may be asked to customize those practices to the nuances and idiosyncrasies of their own classroom, students, and teaching style. Going further, once they have become well versed in the intervention's key ideas, teachers could be invited to serve as innovators, working to develop their own practices that might help to support students' growth mindsets and that could be shared with other teachers. Such collaborative customization is a feature of many of the most successful wise interventions [8,80–82].

Collaborative customization serves two main aims. First, it shows respect for teachers' expertise by acknowledging their central role in making the intervention work and in improving it for teachers who complete it in the future, rather than treating them as passive recipients [83]. Second, it ensures that teachers come away from the intervention with an action plan that fits their own constraints and teaching style [73], making it easier for them to integrate new practices into their classrooms (and achieving what Anthony Bryk and colleagues have called *adaptive integration* [84,85]).

Note that, unlike enlisting teachers as co-creators, collaborative customization takes place at the implementation stage of an intervention. But this does not introduce new costs or complications when implementing at scale because it is fully automated and incorporated into the intervention materials. For example, the most straight-forward instance of collaborative customization entails simply acknowledging, in intervention materials, that the teacher has valuable expertise to contribute and then inviting them to provide regular feedback, as they progress through the intervention, about

elements of the content that resonated more or less strongly with them and to share details of how they might adapt some of the recommendations to better fit their classroom context or teaching style.

Additional Considerations

The "Broken Telephone" Problem

Any effort to improve student achievement by changing teacher behavior faces one more challenge: the "broken telephone" problem. Any intervention that aims to communicate complex and nuanced ideas will inevitably result in less-than perfect understanding due to less-than-perfect communication. In fact, an iron law of intervention research is that the variation in effects will increase exponentially with each layer away from the individuals who stand to benefit from the intervention [84]. This is particularly important in our context.

Most mindset interventions teach the mindset in question directly to the people whom the mindset is intended to benefit. Here, we are trying to change students' mindsets indirectly, by changing their teachers' practices. So, rather than a single step at which less-than-perfect communication can distort the message, in this case, there are two: the communication of the ideas from the intervention designer to the teacher, and then the transmission of relevant ideas from teachers to their students. This problem cannot be avoided [84] but we may be able to mitigate it by devoting even more attention than usual to clear communication.

Long-Term Impacts

The type of intervention discussed in this paper would not aim to change teachers' practices temporarily. Instead, the goal would be to create sustained change that lasts throughout teachers' careers. There is reason to think that if such an intervention were successful in the short and medium term, its effects would persist longer. If teachers develop new practices to support growth mindset over the course of an intervention trial, and then are given enough opportunity and encouragement to repeat those practices in the ensuing weeks and months, they may eventually become habitual and therefore self-sustaining [62]. Moreover, if teachers students' learning and engagement improve as a result of instructional changes they implemented in response to the intervention, those positive results might encourage them to invest further in growth mindset-supportive practices, leading to a positive feedback loop that sustains the new practices over the long term. On the other hand, the effects of educational interventions sometimes fade over time, particularly when the broader environment does not support the changes produced by the intervention [86,87]. We cannot say whether the type of intervention we have described would produce persistent effects, or whether teachers would require "boosters" in the years following the initial intervention. More research will be needed to test these possibilities.

Conclusion

Supporting teachers' efforts to create classroom cultures that authentically support their students' growth mindsets is a formidable new challenge for behavior change researchers. Our analysis of the propelling and restraining forces that affect teachers' ability to make effortful and intentional changes to their teaching practices makes us optimistic that this important goal can be achieved. With the toolkit we have outlined, we see an exciting new frontier for behavior change research that could ultimately transform teaching on a global scale.

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Initiative Paper 3

Measuring Growth Mindset Classroom Cultures

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Abstract

The next step in promoting growth mindsets in youth is to develop supporting classroom cultures in which students both experience a high-quality student intervention and have teachers who received a growth mindset training program. Developing high-quality measures is an important step in the development and testing process of such an intervention and realizing the full promise of growth mindset research. High-quality measures provide insight into questions such as, for whom an intervention is effective and why it is effective, providing important lessons that can be used to better help teachers create a growth mindset classroom culture more reliably and across contexts. This paper introduces a framework and research agenda for developing valid, scalable measures of growth-mindset culture, and describes the challenges researchers need to overcome to create this set of high-quality measures.

Measuring Growth Mindset Classroom Cultures

Every year, teachers must establish a coherent *classroom culture* that sets the rules of interaction. From the start, what the teacher says and does tells students what to expect—what kinds of teaching and learning will likely happen in their classrooms. Teachers maintain that culture, or not, through their daily interactions with students until the end of the year (e.g.,[1–3]). Culture-creation is hard for any teacher to pull off consistently. Different groups of students, and different school contexts, can make a teacher's classroom culture unfold differently from what they had envisioned.

This paper is about how to capture meaningful snapshots of the messy, sometimes unpredictable, but nevertheless important process through which teachers create a classroom culture to support student learning. With that information, we can learn how to help teachers do so more reliably.

In particular, we focus on the driving force behind a classroom culture: its *core ideas*. These are the beliefs and values that give meaning to everyday behaviors and interactions and tie them into a coherent framework that can shape students' behaviors (see paper by Murphy et al., this series[4]). One important dimension on which a classroom's core ideas can vary is its mindset. If the classroom has a *growth mindset* classroom culture, then students of all skill levels, or from any demographic group, feel confident that their peers and teachers believe everyone can learn at a high level (see Box 1 for a definition; also see Murphy et al., this series[4]). In a growth mindset classroom culture, students take for granted that everyone will support them through difficulties on their journey of learning.

At the other end of the spectrum is a *fixed mindset* classroom culture, where teachers and students share the assumption that some students have high levels of fixed ability and others do not. If students in this fixed mindset culture do not rapidly and easily master the content they are taught, they may worry that they will not be respected or supported by the teacher.

Box 1. The Definition of a Growth versus Fixed Mindset Classroom Culture

A *growth mindset classroom culture* is one that embodies the belief that all students have the potential to learn and improve[4]. It supports the growth mindset "meaning system" of goals and the value of failure and effort. In a growth mindset classroom, students would perceive:

- *Teacher growth mindset beliefs*, e.g. "My teacher believes that everybody in my class can be very good at this subject"
- *Classroom learning goals*, e.g., "My teacher cares more about whether I learn and improve than whether I get a high score on any one assignment."
- *Positive interpretation of failure/mistakes*, e.g. "My teacher thinks mistakes are a valuable part of learning"
- *Positive value of effort*, e.g., "In this course, if students find the work hard and get confused, it means they are learning and improving."

A *fixed mindset classroom culture* is one that embodies the belief that only some students possess that ability to learn and improve at a high level, and that ability cannot be changed. This culture includes the fixed mindset "meaning system," such that students would perceive:

- *Teacher fixed mindset beliefs*, e.g. "My teacher believes students can't really change how smart they are."
- *Classroom performance goals*, e.g., "My teacher cares more about whether I get a high score on my assignments than whether I truly learn the material."
- *Negative interpretation of failure/mistakes*, e.g. "My teacher thinks mistakes are bad and should be avoided."
- *Negative value of effort*, e.g., "In this course, if students find the work hard and get confused, it means they probably won't succeed in class."

Whether a classroom has a growth or a fixed mindset culture can play an important role in supporting students' own growth mindsets (for a review, see Murphy et al., this series[4], and Box 1). For example, a growth mindset intervention delivered directly to students (and not teachers) had a positive effect on students' grades in math when their teachers reported more of a growth mindset[5]. A growth mindset culture might also directly promote equitable learning. For instance, in STEM classrooms taught by instructors who reported more of a growth mindset, racial achievement disparities were only half as large as in classrooms taught by teachers who reported more of a fixed mindset[6].

This observational evidence raises the intriguing possibility that a teacher-focused mindset intervention designed to create a growth mindset classroom culture could complement student-focused interventions. That is, it could boost the effects of student interventions, which have been found to enhance achievement among students who have struggled in the past, and which have inspired students at all achievement levels to take more advanced math courses[7]. Thus an intervention that helps teachers create a growth mindset classroom, paired with a student mindset intervention, might reduce disparities in educational outcomes[6,8,9].

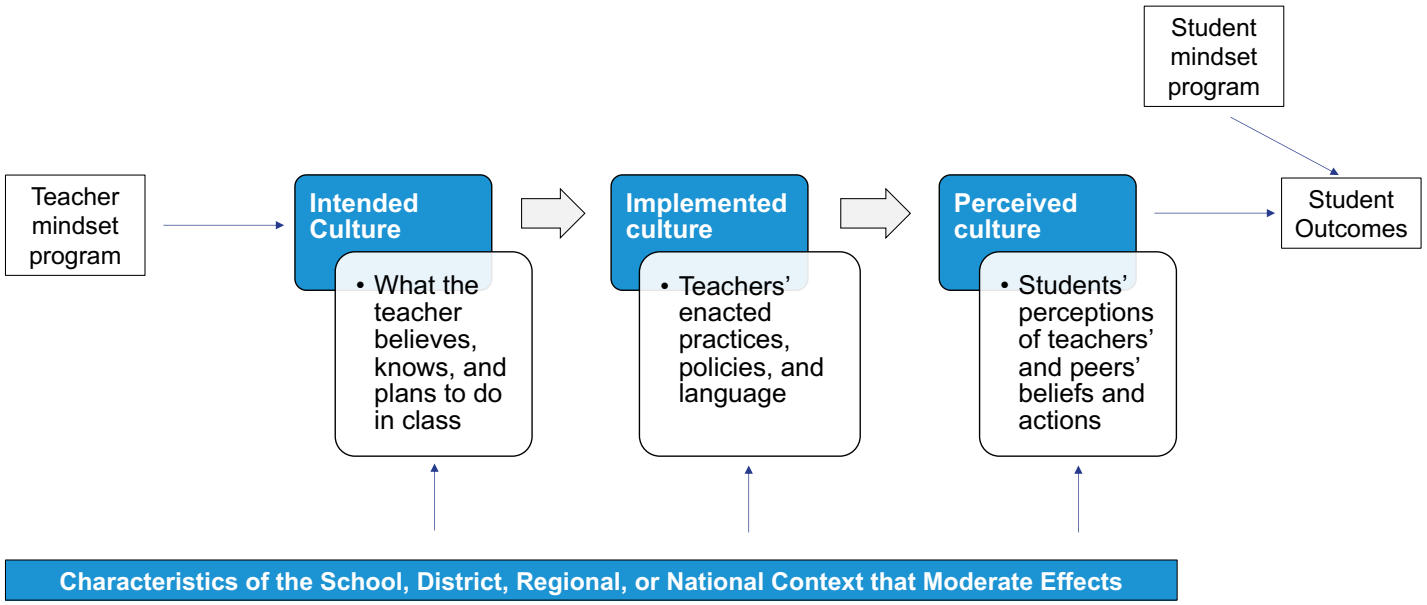
The details of such an intervention—the practices it would train teachers on, and the means for training them—are explained in companion working papers[4,10] .To know whether the new intervention

works, and why, we would need strong evaluation methods[11–13]. For example, we would need to distinguish among versions that fail to motivate teachers to change their classroom culture and those that do not equip teachers to communicate the culture to their students. That is, we need to learn which parts of the intervention are breaking down so that we can learn how to fix them.

What measures should we use to evaluate the impact of a student-plus-teacher growth mindset intervention? The theory of change for such an intervention, depicted in Figure 1, suggests that measures would need to assess the intervention effects on:

- teachers' *beliefs and intentions*: what teachers believe and what practices teachers plan to use based on the training;
- teachers' *implemented* behaviors: what practices teachers actually carry out;
- students' *perceptions*: how the students subjectively experience the classroom culture; and
- the *characteristics* of the school, the school district, and the regional or national context that could make the teacher intervention's impact weaker or stronger.

Figure 1. Theory of change for a complementary teacher-focused and student-focused growth mindset intervention.



Why do we need new measures of the growth mindset classroom culture? After all, we already have many well-validated measures for *students'* growth mindsets, such as the classic measure that asks students to agree or disagree with the statement, "You have a certain amount of intelligence, and you can't really do much to change it." Responses to such questions have predicted motivation and achievement in large samples around the world, including a sample of 550,000 students in 78 cultures and economies [8,14]; also see papers by Burnette et al.[15] and Yeager & Dweck[16].

Measuring student mindsets, however, can only tell us whether students have adopted a growth mindset somewhere along the line. They do not tell us directly whether students experience a growth mindset culture in their classrooms, or what teachers do and say to create such experiences. Fortunately, promising measures have already been developed for each of these aspects of growth versus fixed mindset classroom cultures (these are summarized in Box 2). Here we build on this emerging evidence and preview the research that must be done to produce valid measures of how teacher-focused growth mindset programs affect a classroom's mindset culture.

Overview

This paper examines how to measure each of four components of a growth mindset classroom culture intervention (see Figure 1 and Table 1). First, we focus on teachers' *intended* culture-creating practices (e.g.,[17–19]). Ideally, teachers who receive an intervention would then intend to use practices that create a growth mindset culture. This implies that they would espouse the belief that with the right support their students can learn and develop to a high level. It also suggests that teachers will know about effective culture-building practices, be motivated to use them, and report at least minimal efficacy to do so. To make progress, we must first specify the practices that teachers should intend to use in their classrooms. Then we ask: How could we measure teachers' motivation to use the practices? And how could we measure how well-prepared teachers are to use those practices?

Second, we must look at teachers' actions in the classroom, or *implemented culture* (see refs [11–13]). After teachers experience an effective intervention, we would expect to see them implement growth mindset culture-building practices routinely. For instance, we might see teachers use assessment policies that reward students for fixing their misunderstandings, accompanied by language that assures students that their errors can be useful learning opportunities. That is, we ask: How would we know if the practices were implemented well or poorly? And would those measures be scalable?

Third, we discuss students' *perceptions* of the classroom culture (for examples of important perceptions, see[20,21,22]). If the intervention were effective, we would expect students to feel that the class supports learning, growth, and development. For instance, students would say that the grading practices value learning and understanding, and that teachers treat mistakes as learning opportunities. Measuring student perceptions is important for understanding whether the teacher intervention has gotten through to students. We ask: How can perceptions be measured so that we know whether the teachers' actions truly create a culture that inspires students to act on their growth mindsets—especially students from marginalized or structurally disadvantaged groups?

Finally, we examine how characteristics of the context moderate the teacher-focused growth mindset program (see refs [11,12]). Under ideal conditions, the surrounding contexts at the local, regional,

and national level align with and support teachers' practices designed to create a growth mindset culture. That is, the teachers' practices would be supported by prevailing belief systems at the local, regional, or national level, and schools would offer sufficient time and resources for teachers to implement these practices. We ask: What constraints do teachers face that might prevent them from implementing (or even trying to implement) an authentic growth mindset classroom culture?

Box 2. Three Types of Measures Indicating the Value of a Growth Mindset Culture

1. *Measures of teachers' beliefs can predict classroom inequalities and the efficacy of student growth mindset:*

- A World Bank study of over 9,000 teachers from 10 developing nations found that 43% to 48% of teachers held the fixed mindset belief that they could do little to help a student learn if the student came from an uneducated family or was unprepared by previous grade levels [23].
- Do those kinds of fixed mindset beliefs relate to student outcomes? Yes; in a correlational study of 150 U.S. college instructors in Science, Technology, Engineering and Math (STEM) fields and of over 15,000 STEM students, instructors who reported more fixed mindset beliefs had students who showed larger racial achievement gaps in their courses (.19 grade points on a 4.0 scale) relative to instructors with growth mindset beliefs (.10 grade points)[6].
- Furthermore, a study of 30 scientific disciplines in the United States found that when scholars in a field tended to hold the belief that high, fixed ability is what determines success, fewer women (partial r = -.55) and African-American scientists (partial r = -.54) earned doctorates in that field[24].

2. *Measures of teachers' practices can predict whether students are likely to benefit from their own growth mindset:*

- In the 2018 PISA study, conducted with over half a million students from around the world, students' reported growth mindsets were more strongly related to test scores when they also had teachers who used more growth mindset-supportive practices[8].
- In a nationally representative study with ninth-grade math teachers and their students in the United States[5], students profited from an intervention that increased their growth mindsets chiefly when their teachers endorsed more of a growth mindset.

3. *Measures of students' perceptions of teachers' beliefs and practices can predict their experiences and motivation to learn:*

- An experience-sampling study (which sent students a reminder to complete a perception survey at random intervals) conducted in U.S. universities found that in-the-moment perceptions of a teacher's fixed mindset beliefs were related to lower feelings of belonging on the part of the students, greater imposter feelings, and more negative emotions[22].
- In two large, pre-registered national field experiments with U.S. students aged 13-18 (N = 1,897), students who read descriptions of teachers' learning-focused practices reported perceiving that the teachers held growth mindset beliefs; they also reported that they themselves would engage in more learning-oriented behaviors (e.g,. choosing challenging math assignments rather than easy math assignments)[25].

Table 1. A system for a evaluating a growth mindset intervention aimed at secondary school math teachers, with example measures and research questions.

Category of measure	Example measure	Example priority research questions
Intended culture		
Beliefs	**Teacher-report** How much do you agree or disagree that: "Being a "math person" or not is something about you that you really can't change"	**Issue:** Teachers may try to give the "correct" answer instead of their true belief. **Potential solution:** Include items that give teachers' "permission" to admit to fixed mindset beliefs. **Example**: "There's a lot of talk about things like grit or growth mindset, but deep down an experienced teacher knows that some kids have the ability to excel, and others don't."
Behavioral intentions	**Teacher report** How likely are you to make this into a routine practice: "Make a serious effort in your Algebra 1 class to explain how your course grading policies and practices help students learn and grow."	**Issue:** Most may say they will implement the practices but may not be committed to doing it, because they are simply giving the "correct" answer to the question. **Potential Solution**: Ask teachers to report likely barriers to implementing the practice. **Example:** "How often, if ever, will something get in the way of you making this practice be a routine part of your course during the coming school year?"
Implemented culture	**Teacher peer reports** To enhance and evaluate the implemented culture, arrange teachers in peer coaching professional learning communities that meet once per month. Ask teachers to share video observations, assignments, or student work to demonstrate how they have implemented their mindset culture. Teachers rate each other's observations and documents (e.g. syllabi or exams) on a standardized rubric.	**Issue:** Teachers might not have enough knowledge, or enough observation opportunities, to validly evaluate other's teaching practices. **Potential solution**: Have teachers rate each other in the context of a safe and supportive professional learning community in which teachers feel comfortable being vulnerable. Complement with occasional intensive methods (e.g. coded videos of classroom talk).
Perceived culture		
Perceptions of teachers' mindset beliefs	**Student report** How true was this recently: "In this class, it seemed like my teacher believed that students can't really change how smart they are."	**Issue:** Students might not want to say something they view as negative about their teachers, or they may not accurately infer teachers' beliefs. **Potential solution:** Include items that give students "permission" to admit to that they are perceiving fixed mindset beliefs, and ask about how the teacher makes the student feel? **Example**: "Even though my teacher cares about all of us, my teacher makes us feel like only some of us can truly learn the most challenging material in this class."
Perceptions of teachers' behaviors	**Student report** How true was this recently: "In this class, my teacher seems to like students more if they learn quickly and easily, and don't make mistakes."	**Issue**: Student often have low consensus within a class, making it difficult to determine how much responses are due to differences in student experience versus poor measurement[20]. **Potential solution**: Conduct qualitative studies to understand students' (across diverse backgrounds) thoughts when responding to these question and quantitative studies to test that the? invariance of the measures works the same across groups. Have students rate multiple teachers to disentangle personal characteristics from shared classroom experiences.

Table 1 continued

Category of measure	Example measure	Example priority research questions
Contextual moderators		
Cultural moderators	Measure norms for teacher and classroom norms (e.g., student-focused versus lecture).	**Issue**: There are no existing frameworks to identify the most relevant cross-contextual factors for implementation of a growth mindset classroom culture intervention **Potential solution**: Mine existing data (e.g., PISA data) to identify moderators of the link between growth mindset and learning outcomes across a wide range of contexts.
Implementation fidelity moderators	Measure the school's existing culture of adopting and spreading innovations (e.g.,[26]).	**Issue**: There are no existing measures for evaluating the quality of implementation for a growth mindset classroom culture. **Potential Solution**: Research and development to create new measures and small- and large-scale studies to identify the most efficient, valid measures that can be administered routinely and at scale.

The Intended Culture: Teachers' Mindset Beliefs and Intentions

The first things we need to know in evaluating a teacher-focused mindset intervention are:

1. which teachers shifted their beliefs and were motivated to create a growth mindset culture and which teachers did not, and;
2. whether teachers learned enough about effective practices to create a growth mindset culture.

For example, if we learn that fixed mindset teachers continue to hold a fixed mindset after the intervention, we know that the arguments presented in the intervention need to be revised. Similarly, if we learn that teachers intend to implement practices that will not be effective in changing the culture, then we know that we need to revise the intervention content to boost their understanding of how to do so.

Beliefs That Motivate Teachers to Create a Growth Mindset Classroom Culture

When people's intentions align with their core beliefs, they are more likely to follow through with implementing the intended behavior[27]. Teacher beliefs are typically measured by asking respondents how much they agree with the statement, "Students have a certain amount of intelligence, and you can't really do much to change it." But as the idea of growth mindset has become more popular in education, it has become socially undesirable to admit to having a fixed mindset. For example, U.S. and international data show that between 70% and 80% of teachers disagree or strongly disagree with traditional fixed mindset statements[5,28,29]. However, around 40% of teachers in a World Bank survey conducted in 10 developing nations[23] agreed with mindset beliefs that are similar to fixed mindset beliefs, such as that there is little they can do to help students who come from poor families or were unprepared in previous years. Thus, we need to identify or develop measures that limit the degree to

which teachers answer with what they believe is the "correct" (i.e., socially desirable) response. To do so, we offer four ideas that could be directly investigated in experimental research.

Give teachers permission to admit to a fixed mindset. One hypothesis is that it could be effective to acknowledge that teachers may be legitimately skeptical of popular ideas in education such as growth mindset, and then allow them to express fixed mindset beliefs as a harsh reality that realistic and savvy teachers know to be true. For example, they could be asked to agree or disagree with the statement, "There's a lot of talk about things like grit and growth mindset these days, but deep down an experienced teacher knows that some kids have the ability to excel and others don't." Research should identify the best way to give teachers permission to admit to fixed mindset beliefs without making the item being so complex that it disrupts the cognitive response process.

Measure beliefs about student motivation. A second hypothesis is that it could be effective to ask about related beliefs that raise fewer concerns about social desirability but that may be strong predictors of the practices that create fixed mindset cultures. For instance, teachers may feel uncomfortable saying that students lack the intellectual potential to succeed, which may feel as though they are blaming children for something out of their control. But they may feel more comfortable saying that other characteristics that are related to performance are fixed (such as student motivation). Research has revealed beliefs that are adjacent to fixed mindset beliefs (see Box 3); these could be valuable for creating a new, comprehensive measure.

Change the response scale. A third hypothesis is that changes to the response scales—from agree/disagree to alternative forms—could reveal fixed versus growth mindset beliefs that are likely to show up in teachers' practices. For instance, items could ask teachers how often they think in a fixed mindset way, rather than asking them whether they agree with a fixed mindset belief in general. An item could ask, "How often, if ever, did you wonder whether all of your students had the intellectual potential to fully grasp the content you were teaching in class?" Then teachers could choose among responses such as "Never," "Some of the time," and "All the time." Indeed, pilot data we collected from 260 U.S.-based teachers found that compared to asking teachers merely to agree or disagree, this frequency response scale produced greater variation in responses, without reducing validity. (A limitation of this scale, however, is that it cannot be used right after an intervention, because teachers will not have had enough time to entertain new thoughts).

Box 3. The "Pygmalion in the Classroom" Study Involved a Mixture of Mindset Beliefs

The earliest and perhaps best-known study of teachers' beliefs is the "Pygmalion in the classroom" experiment conducted by Robert Rosenthal and Lenore Jacobson in 1961. Teachers were led to believe that some of their students would "show an inflection point or 'spurt' within the near future" on the basis of an IQ test that they had purportedly taken. Teachers were also told that "these spurts can and do occur at any level of academic and intellectual functioning," even among "children who have not been functioning too well academically," which drove home the belief that growth in intelligence could apply to all groups. In fact, the researchers randomly selected the names of students who were said to be showing a "late blooming" spurt in IQ. In the original study, and in a meta-analysis of many subsequent studies[30], children in younger grades whose names had been randomly selected and provided to teachers did, in fact, show a greater increase in cognitive performance over the year, presumably because the teachers used more learning-oriented practices with them. The effects of teachers' beliefs were most pronounced among students who were at the lowest levels of previous IQ or were facing the most structural disadvantages. That is, a growth-oriented belief in students' potential t ended up narrowing group disparities in academic achievement[30].

Although the Pygmalion experiment showed that, in general, teachers' beliefs can affect student learning, they did not identify which beliefs can be most consequential. Indeed, several different flavors of mindset beliefs could be at work: beliefs about whether intelligence in general can be changed[6,31], beliefs about whose intelligence can be changed (e.g., students from rich versus poor families) (see Sabarwal et al.[23]), and beliefs about whose abilities can reach high levels[24,32].

Adapt established methods for overcoming social desirability response bias. Last, survey methodologists have developed many methods for reducing social desirability response bias. For example, the *randomized response technique* or the *item count technique* ask participants to privately answer multiple or alternative questions. Responses to the key questions have to be inferred in the aggregate and are not directly known by the researcher (either because participants flipped a coin and chose one question to answer, or they answered one question on a list of four). Participants report undesirable behaviors more often because they know their answers are confidential (see the cited papers for technical details[33–36]; also cf. the bogus pipeline technique[37]. Could these methods, or others like them, be adapted for mindset research?

Teachers' Intentions to Create a Growth Mindset Classroom Culture

Even if teachers adopt growth mindset beliefs and are fully motivated to create a growth mindset classroom culture, they may not know how to do so well in their own classrooms. Here we examine three ways to measure intended practices.

Closed-ended ratings of candidate practices. First, teachers could be asked directly how often they plan to use specific culture-creating practices. For example, teachers could be asked whether they plan to "say or do something to explicitly celebrate students' mistakes and explain

that they are opportunities for the class to learn more" (a learning-focused practice), or "focus on identifying and nurturing students who have a real talent and natural ability for learning the course material" (an ability-focused practice). However, teachers may not have considered the practice until the researcher suggested it on the survey. Therefore, the item may not capture a true intention to enact a given behavior. It might therefore be useful to solicit open-ended responses, or to use performance tasks (discussed below) as well.

Indeed, closed-ended ratings present a second challenge: once the teachers read about a practice, it might seem more reasonable to them than it might have previously. This could inflate the measure of intentions to engage in learning-focused practices. One solution may be to ask teachers to rate other dimensions of the practice that produce more variation. For example, teachers could be asked to what extent they expect barriers, such as demands on their time or pressure from administrators or families, will stand in the way of implementing it. This would provide insight into how important teachers think the practices are and how committed they are to implementing them. In fact, research on measuring attitudes has shown that qualities related to the strength of people's attitudes (e.g., how strongly they hold an attitude or how important it is to their self-concept) can often explain variation in the attitude-behavior link, beyond the attitude itself[38]. Similar processes may be at play when it comes to mindset intentions, although this hypothesis needs to be tested.

Open-ended responses to scenarios or videos. Second, teachers could be asked to respond to scenarios or videos of classroom instruction by describing what they would do in the situation presented to them. For example, in a technique called classroom video analysis (CVA[39–41]), teachers watch short videos of other teachers' daily classroom instruction. Facilitators then ask them open-ended questions about how the teachers and students interacted. The teachers' responses are categorized according to a rubric that is mapped to a framework for high-quality instruction. However, the effectiveness of video analysis depends on the videos themselves and the practices coded in the rubric. Currently, we have no library of validated videos that could be analyzed in the context of growth mindset classroom culture; existing videos were developed to analyze traditional pedagogical practices[40,41]. Nor do we have a coding rubric for mindset practices, though researchers could develop a validated library and rubric in the near term.

CVA is also limited by the need for people to code teachers' video responses, which makes the method costly to scale up. But researchers are developing promising ways to automate coding using artificial intelligence (AI) and natural language processing. In one study, human coders' responses were used to train machines, which then produced answers similar to those of human coders[40]. Such automated scoring could greatly increase the potential to scale CVA.

Performance tasks. Third, teachers' intended classroom culture-creating actions could be revealed through performance tasks. For example, a teacher could be asked to prepare a syllabus or

a speech for the coming school year, or to deliver a model lesson; their behaviors would be recorded and coded by expert raters. A related option is to use a situational judgment task, which asks teachers to say how they would respond to hypothetical situations[42].

Despite their many advantages, performance tasks also have well-documented limitations. For example, they may foist teachers into situations they are unlikely to encounter in real life, undercutting validity (reviewed in Table 1[43]). Another important limitation—and one that is underappreciated—is the possibility that the intervention and task may be too closely aligned. When researchers align tasks too closely with what participants in an experiment were just taught, effect sizes tend to be larger than they would be for real-world behavioral outcomes (see Cheung & Slavin[44]). In an intervention to encourage growth mindset classroom culture, teachers might display the intended behavior in the narrow form they learned in the training but might be unprepared to transfer their knowledge to broader situations (see a discussion of such over-alignment in Bailey et al.[45]). A challenge for research, then, is to identify performance tasks that are sensitive to changes induced by an intervention but not over-aligned with a training program, and that therefore are more likely to predict real-world behavioral effects.

Summary of the Intended Culture

Research needs to assess how well teachers have integrated their beliefs and intended behaviors into a coherent set of planned culture-creating actions. We need to learn which beliefs and meaning-system variables can turn into everyday interactions that communicate a growth mindset culture to students. For research and development (R&D), the challenge is to ask about the beliefs in a way that elicits teachers' authentic thoughts, and that distinguishes among people all along the spectrum from fixed to growth mindset. We are optimistic that researchers can develop measures that are ideal not only for high-touch, high-cost, small-scale studies, but also for low-touch, lower-cost, larger-scale studies. Directly investigating that possibility should be a priority.

The Implemented Culture: Teachers' Classroom Practices

What teachers say and do in real life, and how they structure their classrooms, constitute the *implemented culture*. Many things can get in the way of enacting the behaviors that are consistent with our intentions[27]. Thus, we cannot assume that teachers' beliefs and intentions will perfectly map onto their implemented practices. Yet it is impossible to capture everything that a teacher says and does. How do we reliably measure teachers' actual implemented practices, and do so at scale?

Can We Just Observe Teachers and Their Classrooms or Ask Teachers What They Did?

Third-party observations. To capture samples of instruction, researchers have often used periodic *third-party classroom observations* (either in person or via recordings)[46–48].This approach works well for capturing overall instructional quality (whether the class in general is high-functioning[46]), but not for assessing specific teaching practices. The validity of classroom observations depends in part on what practices the observers capture on a particular day, and on how easy it is to put those discrete interactions into a broader context of culture creation over the year[49].

For instance, say we were interested in the extent to which teachers frame struggle and mistakes as normal and necessary parts of learning. We would be most likely to be able observe this when students were first learning a new topic. But even if we observed the introduction of a new topic, we would only capture a thin slice of the context. The teacher might tell students that struggle and mistakes are normal and necessary when introducing new topics, but might communicate contradictory beliefs at other times (e.g., when giving students feedback on an assignment or test). Direct observation is also unlikely to be scalable, as it requires trained staff to observe each classroom on multiple occasions, or to collect and code many videos.

Retrospective self-reports. Rather than observe them in the classroom, we could ask teachers to report retrospectively about specific culture-creating practices (e.g., how they discussed challenging exams; how they introduced a new, challenging concept; or what they said if students were struggling). This approach faces at least three major challenges. The first is the inter-subjectivity problem: teachers may not interpret an item in the way the researcher intended. The second is biased recall or reporting. Teachers may think it is socially desirable to, for example, "celebrate a student who corrected their mistakes," and so they may overstate how frequently they did so, or how well it was received. So, a retrospective report would need some kind of validation with other reporting sources. The third is burden on the teachers. It is not usually possible to reduce teacher workload to provide extra time for completing surveys. Unless survey responses are integrated into a teachers' workflow, repeated measurement may create a burden and reduce the quality of data collected.

Nevertheless, retrospective reports have many advantages. One is logistical: it is far easier to ask a teacher questions than it is to have an observer be present in class and then have multiple raters code the observed events on a rubric. Another advantage is the teachers' own expertise regarding their experiences. A teacher's self-report of the practice might provide information that an observer would miss. In general, people can report accurately when they are asked clear questions that make them feel comfortable telling the truth (e.g., [43,50]), so a high priority for research is to optimize retrospective report measures.

Artifacts and passive data. Researchers could also observe or collect artifacts in a classroom, such as growth mindset wall posters or syllabi, or they could examine passive data, such as text records of student-teacher communications on a learning management system. Artifacts can shape

and transmit classroom culture, and are undoubtedly an exciting area for novel research. But they can also be ambiguous—they do not carry the same meaning in all contexts, and, some (e.g., student-teacher communications) may raise privacy concerns. As a result, measuring culture only through artifacts or passive data can produce spurious associations that mislead educational policymakers and frustrate educators[51]. Box 4 describes a cautionary tale from New York City, where a spurious link between bulletin boards and student achievement led administrators to enact and enforce useless policies.

In a similar spirit, we suspect that counting the number of growth mindset posters on the wall is unlikely to help us distinguish between teachers who are putting in minimal effort (i.e., just sharing posters) and those who view posters as one part of building a growth mindset culture but who also consistently use learning-focused practices. Thus, any analysis of artifacts should be accompanied by broader contextual information about the classroom culture (for instance, teachers' beliefs and intentions, other forms of teacher practice, and/or student perceptions).

Box 4. New York City's Bulletin Board Policies: A Cautionary Tale for Analyzing Classroom Artifacts

In 2001–02, New York City district administrators had found a correlation between the neatness of the bulletin boards in a classroom and student achievement. Based on this finding, they instituted guidelines for the content and organization of bulletin boards, which were enforced in accountability and teacher evaluation policies.

District administrators patrolled the hallways with bulletin board rubrics and had serious conversations with teachers whose bulletin boards were unkempt. Teachers responded by making superficial changes to their bulletin boards (but not by changing their instruction). For instance, teachers would type up what their students wrote for the bulletin boards, correcting any mistakes, rather than having students go through three or four revisions[51]. "It's not in their handwriting anymore, which is too bad," one fourth-grade teacher in Brooklyn said. "But when an administrator walks by with a clipboard looking for five elements of a good bulletin board, at least they won't take it down because of an eraser mark"[51].

The root of the problem was that the research analysts failed to consider the possibility that the underlying classroom culture in the neat bulletin-board classrooms was the most important factor for student learning, not the bulletin board itself. Teachers who cared about student work and voice also put time and attention into their bulletin boards, and it was the caring classroom culture that lifted student achievement.

A superficial analysis of growth mindset classroom culture could also be misleading—for instance, one that counts the number of posters emphasizing growth and learning, or one that examines only how student work is displayed without putting it into the context of instruction.

Combining methods. The methods we have described all have limitations. But if we combine them, we may be able to compensate for those limitations and produce reliable and valid measures of implemented culture. A critical issue will be how to deal with disagreements. For instance, if a

student says a teacher did something, but the teacher did not say that, is that noise? Or does that disagreement say something meaningful about the classroom culture?

We note that measurement development research will need to keep in mind the scaling challenge: measuring practices can be time- and resource-intensive. Therefore, the full array of measures is likely to be limited to smaller studies, or to rarer well-funded large evaluation studies.

Methods from Professional Learning Communities

Another approach is to build on methods in which teams of teachers routinely collect high-quality, culturally informed classroom observations, such as "lesson study," which was originally popular in Japan[52,53], or the Protocol for Language Arts Teaching Observations (PLATO)[54]. Teachers observe each other teaching and then discuss how what they saw met the goals for the lesson, or not. For example, teachers capture on video aspects of their instruction that they are proud of and want to share, or that they are struggling with and want feedback on. Within the context of helping each other and learning together, peers score video clips, which become the basis for discussion in peer coaching learning communities. This presumes, of course, that there is a safe community in which teachers felt comfortable revealing imperfections in their teaching.

Classroom culture coaching meetings could be timed around crucial culture-creating events—for example, the first week of school, a major assessment, or the start of a new unit. Teachers could be instructed to capture themselves using a key practice for that event—for example, how they talked about mistakes. Then the observational data collected for peer coaching could be used for research. For example, researchers could code the videos themselves or (to alleviate privacy concerns) analyze the ratings provided on the rubric during coaching sessions. Because peer coaching is a part of teachers' expected routines, this process could be scalable and sustainable. This method is not unbiased—for instance, teachers might cherry-pick nonrepresentative teaching practices, or they might be positively influenced by the very act of being observed (e.g., Hawthorne effects). Therefore, we need further research on these possibilities.

The Perceived Culture: Students' Classroom Experiences

How do students interpret their teacher's intended and implemented culture-building practices? Are teachers effectively communicating to all students, regardless of their backgrounds and cultures, that everyone has great potential and capacity for intellectual growth? To answer this question, we can turn to the *perceived culture*—students' subjective experiences in the classroom, as opposed to what the teacher thinks, says, and does.

Collecting students' reports of their experiences is an effective way to learn about a classroom

culture (see Box 5 for a practitioner case study). That is not surprising: students know better than anyone else how the classroom experience impacts their own thoughts, feelings, and behaviors. Student perceptions are a low-cost, readily scalable, and likely highly informative source for assessing the classroom's mindset culture. Decades of educational research around the world has demonstrated that student perceptions can predict learning outcomes[22,42,55–57]. Because they can be embedded in regular classroom routines, measures of student perception are scalable—as demonstrated by the professional learning platform Copilot (Project for Education Research That Scales, https://www.perts.net/elevate), which lets teachers regularly collect student perception data and receive rapid feedback that helps them improve their classroom culture. Thus, student reports of their classroom experiences are a valuable tool for evaluating large-scale interventions; for studying the factors that influence, and result from, differences between and within classrooms (such as inequalities across demographic groups; and for teachers' own self-evaluation and continuous improvement.

However, if student reports are to reach their full potential as a tool for measuring classroom culture, several challenges lie ahead: reducing students' feelings of pressure to say only positive things about the teacher and class (i.e., social desirability bias); ensuring that both the measures and the way they are analyzed capture consensus across students while preserving important individual differences in experiences (e.g., differential treatment); and ensuring that the measures can effectively capture change (e.g., in response to an intervention).

Box 5. Schools2030: Using Culture Measures to Identify Promising Teacher Practices

Can high-quality measures of a classroom's culture be used to identify promising growth mindset practices that teachers have developed themselves? If so, could these "locally grown" teaching practices scale more readily in a given community? Schools2030 is seeking to find out. Although the initiative covers more than just growth mindset—it involves socially and emotionally supportive practices in general—it offers a blueprint for how strong classroom culture measurement could lead to better and more contextually appropriate teacher-focused interventions.

Schools2030 is a 10-year participatory action research and learning improvement program in 1,000 schools in 10 countries: Afghanistan, Brazil, India, Kenya, Kyrgyzstan, Pakistan, Portugal, Tajikistan, Tanzania, and Uganda. In each nation, measures of school and classroom culture are being administered in a diverse sample of 100 schools. The measures will identify "bright spot" teachers (see papers by Heath & Heath[54] and Pascale et al.[55]), who lift achievement for the most underserved communities of students, as measured by learning assessments, and who at the same time create positive and supportive classroom cultures, as experienced by their students (Schools2030 calls these "holistic learning outcomes"). This approach assumes that some teachers have developed local, practical wisdom that works for students in their own communities. However, they may not know whether their practices are truly making a difference, and they may rarely have the opportunity to transfer their wisdom to other educators. Using the Schools2030 methodology, bright spot teachers can be identified and then involved as co-creators of novel intervention materials (see also Bryan et al., this series[10]). If we identify bright spot teachers using measures that map onto a coherent framework for student success, and we involve them in creating training materials tailored to a certain student population, their most effective practices can spread organically in the community, rather than remaining isolated.
The Schools2030 approach suggests an innovative way for researchers to use growth mindset measures in the life cycle of developing and then evaluating instructor-focused growth mindset interventions. For example, in a given country, student perception measures could be combined with student test score data to identify teachers whose classrooms have smaller achievement gaps and who create a strong growth mindset classroom culture. Those teachers could be invited to help develop a library of learning-focused (rather than ability-focused) culture-building practices (see Murphy et al., this series[4]). These collaboratively developed practices could be tested by randomizing other teachers to receive them or not. Such a process could provide the rigorous evidence needed to evaluate whether the practices are effective. It could also help customize interventions in a given country much faster.

Reducing Social Desirability Bias

Students' reports of their teachers and classes may suffer from a hesitancy to voice negative thoughts and feelings. As with teacher beliefs (see the section on intended culture above), researchers could test methods to optimize student perception measures, including:

- writing questions that give students permission to admit to fixed mindset perceptions;
- asking about different, related perceptions that are less likely to raise social desirability concerns (e.g., using items that focus on students' own feelings rather than guessing the

teacher's beliefs, such as "I feel comfortable making a mistake in class" rather than "The teacher thinks mistakes are a learning opportunity");

- expanding the response scale beyond simply agreeing or disagreeing with a statement (e.g., by asking questions such as, "How often have you raised your hand in the past month when you were unsure of the answer to a question?"), and;
- adapting established methods for addressing social desirability response bias (see the discussion of the item count technique above).

Capturing Consensus while Preserving Individual Experiences

Once we collect student perception measures, how should we analyze them? Traditionally, the culture of a classroom has been defined by the average of its student perception scores. But an average cannot tell us the extent to which students agree with each other on either the nature of the culture or its quality[60–65]. Unfortunately, many measures of student classroom experiences show little consensus, suggesting that much of what students report is based on their individual experiences or personal characteristics[66–68]. When we measure student perceptions in a classroom, we need to understand what this variability across students means (e.g., is it an artifact of poorly worded questions? Is the response scale being interpreted differently? Or does it represent real differences in experiences and personal characteristics? (see Bardach et al.[69]). Then we need to develop measures that reliably capture both shared student experiences and individual or group differences (see Bardach et al.[20]).

Cultural Context Moderators

A successful intervention will leave teachers excited and motivated to change their classroom culture. But even the best intentions might falter due to external factors. Indeed, the classroom culture is nested in a district, regional, and national culture (see Murphy et al., 2021, this series[4]).

Teachers might struggle to balance their desire to change classroom culture against the time commitments placed on them by administration. Or, if their school community does not value the work they are doing, they might feel alone in their efforts and get discouraged. Moreover, teachers' prior knowledge, characteristics, and experience—all of which can be influenced by a school system's hiring and recruiting practices—might impact how easily they understand the core intervention content.

For example, in some developing nations, teaching is not a highly valued profession. Teachers may have low levels of training, which can make it difficult to learn any new practices. Further, if a nation's education system typically uses a fixed mindset culture, then teachers may have very little direct experience with the growth mindset culture they are being asked to create

We propose that to find and measure contextual factors that boost or inhibit a growth mindset classroom culture, we will need to integrate our understanding of how a growth mindset culture is built

with conceptual models that exist for identifying moderators of educational treatments (e.g. [11,12,70,71]; also see frameworks in the implementation science sector[13,70]). That would allow us to answer questions such as: What skills do teachers need to successfully engage with the intervention? What competing demands may hinder teachers' participation? And what resources do schools need to invest in to ensure that teachers successfully engage with the intervention?

Even if teachers implement practices well, students might not show the expected changes, such as better learning outcomes. For example, if a school's norms are strongly oriented toward a fixed mindset, changes in a single class might not be powerful enough to overcome the broader context and affect student outcomes[7]. For instance, a recent study using data from the 2018 Programme for International Student Assessment (PISA) concluded that the association between growth mindset and learning depended in part on whether the national culture tends to support upward economic mobility for students[72]. If students believe they are less likely to get ahead in their country's labor market, then despite holding a growth mindset they may not focus on school achievement as a path to success. Thus a growth mindset may be less likely to predict student achievement in those countries. What this finding fails to tell us, however, is what specific teacher, administrator, community, or policy factors undermine the benefits of a growth mindset, or how we might alter them. The 2018 PISA data could be analyzed further to identify more concrete cultural moderators that are worth targeting directly.

Research and Development

Many of the measures we recommend have not been developed, and therefore it may appear as though we are years away from being able to make progress. In some ways, this is true, and it will be important to not get too far ahead of the state of the science. At the same time, as we outline below, many priorities for R&D come out of this framework, and the research community could start working on them immediately.

Large, Multi-Measure Validation Studies

For example, R&D should produce improved measures of teacher beliefs and intended practices. When these are paired with student perception measures in a large validation study, we can test which teacher measures best distinguish among teachers who successfully create a growth mindset culture and those who do not. When combined with smaller embedded studies that include third-party observers or ecological momentary assessments (EMAs), such studies can also be used to evaluate how well student perception measures capture consensus about the classroom culture while preserving important individual differences in experiences.

In these validation studies, we can go beyond self-reports to look at performance tasks, artifacts (e.g., coding of syllabi), and passive data to get at the implemented culture. These may be less likely to suffer from social desirability bias or differences in frame of reference; when used as a

complement to self-reports, they can open a window onto how beliefs are manifested in everyday life. Still, these measures may be inefficient to collect and could be misleading if not paired with other measures, and so large validation studies will be needed to select the optimal combinations. Further, artifacts and passive data will be difficult to collect in national contexts that lack sufficient Internet access.

Importantly, it is not enough to show that a measure predicts student outcomes at one point in time. Validation studies will need to include multiple assessments to ensure that measures are sensitive to *changes* over time. This is the most informative way to evaluate an intervention's effectiveness, since a measure that captured only stable characteristics, and not change, would not show condition differences even if a high-quality intervention were delivered.

Quantitative Methods

The validation studies will offer new occasions to improve quantitative methods of analysis. One open question is how teacher beliefs and intentions, and student perceptions, should be aggregated into composites. Should a *classical test theory* perspective be used (i.e., taking the weighted or unweighted average of individual items)? Or should we employ an *item response theory* (IRT) perspective, in which different items are easier or harder to agree with, to differentiate teachers at different parts of the spectrum? Some research on student growth mindset measures in the United States has used an IRT approach and shown robust correlations with test scores[28]. Should a similar approach be used for teacher measures?

Qualitative Methods

R&D should not only involve quantitative methods such as experiments and survey analysis. It should also draw on qualitative methods such as cognitive pretesting and focus groups. Cognitive interviewing can assess whether questions are being interpreted differently by different groups of individuals[73]; therefore, it will be essential for developing valid measures that can be used across contexts in different populations.

Focus groups can unearth novel ways to capture teachers' or students' thoughts and feelings. For example, recent focus groups with teachers revealed that although teachers strongly believed that students can increase their math ability, many felt that student motivation is more fixed and represents an impediment to learning. This insight suggested a new method for measuring teachers' beliefs about students' potential to learn that, based on teachers' openness about these thoughts during the focus group, may well suffer less from social desirability bias.

Research Collaborative

Experiments or focus groups might reveal new limitations, thus requiring more R&D to develop new or revised measures. This iterative process underscores the need for a research collaborative that coordinates measure development and data collection and makes them more efficient. Therefore,

we recommend creating a research collaborative, or "hub," that will sit in the middle of a large and coordinated set of investigators working toward the development of globally valued and scalable measures of growth mindset culture.

What should the research collaborative seek to accomplish? It can develop a family of validated measures, some new, some old, and some adapted, similar to what researchers have done in other fields. Examples include the Stress Measurement Network (https://www.stressmeasurement.org/), which clarified a contentious field of stress measurement; and the NIH Toolbox (https://www.healthmeasures.net/explore-measurement-systems/nih-toolbox/intro-to-nih-toolbox/cognition), which brought needed coherence to the measurement of executive functioning. These networks were important because there were many competing measures of the same constructs, leading to too little consensus in the field. The measurement networks helped bring homogeneity to the way researchers thought about the constructs and measured them, so that they could compare results meaningfully and accumulate knowledge.

Unlike a network in the growth mindset field, however, both of these networks had a head start. They drew on measures that had been around for decades; growth mindset research has only recently started moving toward measures of classroom culture, rather than students' mindsets only.
Thus what mindset researchers need to accomplish is more ambitious. We must both develop novel measures and aggregate them into an open, accessible toolkit that a large, international research collaborative can use. Doing so may require even more coordination and investment than past measurement networks needed. That is why we recommend that the field develop a global research collaborative to conduct this research, and soon.

Conclusion

Research on growth mindset classroom cultures suggests a tantalizing possibility: when students both experience a high-quality student intervention and have teachers who received a growth mindset training program, we will see greater student achievement and smaller inequalities. The field is just beginning a long journey toward realizing that possibility, and there will undoubtedly be many challenges to overcome in developing an intervention with robust effects across national and regional contexts. To learn from those unexpected challenges, and to adjust the intervention programs accordingly, we will need high quality measures. Indeed, developing quality measures of a growth mindset classroom culture will be an important step in realizing the full promise of growth mindset research

The difficulty of the path ahead, however, does not diminish the importance of this journey. With coordination and investment in shared research infrastructure, and equipped with the frameworks

proposed here, we are confident that the field can move closer to real, lasting, and meaningful improvements in educational systems around the world.

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Initiative Paper 4

Research Infrastructure and Study Design

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Abstract

To determine "what works, for whom, and under what conditions," interventions need to be studied in diverse and heterogeneous samples. At an international scope, this degree of heterogeneity is unlikely in a single study and instead requires conducting multiple studies of the same intervention across the globe. In this paper, we provide an overview of the infrastructure required to coordinate such a series of studies, including the methodological and measurement developments that would be needed. We also discuss implications of this shared focus for the design of individual studies and the analyses of outcomes across studies. Throughout, we situate these needs in the context of developing a teacher mindset intervention that is intended to be implemented broadly in classrooms around the world.

Research Infrastructure and Study Design

Over the last 20 years, the number and quality of intervention studies in education has increased rapidly, both in the U.S. and internationally. For example, since the Institute of Education Sciences—the research arm of the U.S. Department of Education—was founded in 2002, it has funded more than 300 efficacy and effectiveness studies[1]. In the same period, over 150 randomized evaluations have been funded by the Educational Endowment Foundation[2], and 3ie, J-PAL, and the World Bank have funded many other education-focused evaluations. In most cases, these studies have examined the effects of student-, teacher-, and school-level interventions on student-level outcomes (often achievement).

The motivation for this research has been to determine "what works" so that schools will be able to immediately implement these interventions, thereby improving student learning. Realizing this vision has been difficult, however, as the goals of research and practice differ. For example, while researchers have prioritized estimating the average *causal* effects of interventions (often conceived of as "the" effects), the practitioner community has been much more focused on questions of implementation, transferability, and generalizability. Put another way, practitioners continue to be motivated by local (not global) concerns, and many of these concerns involve questions of context: Does this intervention work everywhere? Under what conditions? What supports does it need? Will it work here?

Researchers have begun to highlight this disconnect, documenting that the kinds of schools and students included in research are often more homogenous than and quite different from the populations the research is intended to serve [3,4]. With this in mind, Christopher Bryan and colleagues[5] have called for researchers to embrace heterogeneity—in participants and contexts—at all stages of their research.

One example of embracing heterogeneity can be found in the National Study of Learning Mindsets (NSLM)—the largest randomized experiment to be conducted in a random sample of high schools[6]. The NSLM was designed from the outset to test hypotheses regarding not only the average effect of a growth mindset intervention, but also variation in its impact across classroom and school features[7]. The results showed that this intervention would likely not be effective everywhere, but that it could be quite effective when teachers themselves had high growth mindsets.

While the NSLM shows the promise of focusing on heterogeneity, conducting the study required far more resources than most randomized trials have. For this reason, Bryan and colleagues[5] argued that to embrace heterogeneity—and thereby bridge the research-practice divide—mindset researchers need to focus on developing and supporting shared infrastructure. This will be particularly essential if we aim to answer local questions at a global scale, since resources to conduct multinational studies are limited.

Shared infrastructure would enable researchers to collaborate and work in concert with one another, developing and testing interventions in contexts around the world. Importantly, unlike current ad hoc partnerships, this infrastructure would allow studies to be planned and coordinated in relation to one another, thereby efficiently filling gaps in knowledge. Studies could be conducted because of their potential to teach us something new, rather than because of a convenient partner or opportunity. This is essential, because efforts to pool findings from trials using meta-analysis have been highly uneven—some contexts are overstudied (such as urban and suburban schools) and others are not studied at all (such as rural schools, which make up a plurality of schools in many countries, including the United States).

Here we provide a framework for the shared infrastructure we would need to realize this vision of providing evidence for local decisions at a global scale. Our goal is to offer an accounting of the scientific, statistical, and practical problems that must be overcome if we are to understand for whom, where, and under what conditions interventions target to students, teachers, and schools can be effective. Throughout, we situate this accounting in the context of developing a teacher growth mindset intervention (an outgrowth of the NSLM). This intervention aims to change teacher mindsets and behaviors and thus to change classroom cultures, thereby letting students realize the benefits of their own growth mindsets. Developing and testing such an intervention requires that we consider local, school, and classroom cultures. If accounting for such contexts is essential for testing, it is even more essential for developing the mindset intervention, which will need to be implemented with high fidelity in a wide range of schools. Importantly, the infrastructure we propose is not specific to this intervention. We anticipate that it will be useful for a wide range of interventions globally.

Coordinating Infrastructure Needed

In single studies that involve only a few schools, most research activity is directed by a single staff and coordination is relatively straightforward. But to execute a coordinated series of studies across many sites according to a defined protocol requires a substantial infrastructure. This is especially true for international studies, where different norms, cultures, and educational structures must be expected. First of all, we will need an infrastructure to develop a protocol that is sensitive to the norms and cultures of the participants. But we also need it to ensure adherence to the protocol, as well as efficient collection, analysis, and synthesis of data across sites or countries. In international studies, it is also helpful to have a point of contact in each country to coordinate activity there.

Coordination Needs

As a complex undertaking, a suite of studies needs to be organized via an explicit protocol to ensure both consistency and transparency, much like a large-scale multi-site clinical trial. The protocol explicitly describes how the studies are to be conducted, including the selection of sites, final preparation of materials and measures, training of research staff, implementation and monitoring of the intervention, data collection procedures (including collection of moderator data), communication with sites or countries, data analysis and archiving, and preparation of reports.

The protocol can be open, meaning that it describes the minimal conditions for participation so that new sites or countries can enter after the initial studies are planned. Elements of the protocol include specification of (and data collection regarding):

- Sampling plans
- Intervention characteristics (any adaptations should be measured)
- Comparison group conditions (measured in the same way across studies)
- Potential within-study moderators (e.g., [5])
- A common set of between-study moderators (measured in all)
- Outcomes (or proxies)
- Open data-sharing practices and repositories for data

In each of these categories, data will need to be coded in a similar way across countries.

Specifying each of these measures—e.g., outcomes, dosage, and context—will need to follow an iterative process. That includes the intervention itself, which will need to be pilot tested and refined before it is ready to scale. Moreover, development and testing must not be conducted in a single country or by a single entity; instead, development must truly global, necessitating considerable coordination.

Analyses will also need to be coordinated—not only the final meta-analyses, but also analyses conducted during the course of the study regarding variation among the moderators and evaluations of new countries and samples in relation to the existing evidence. To coordinate analysis, the study will need infrastructure and tools for:

- Reporting data (e.g., something similar to clinicaltrials.gov)
- Landscape analyses (e.g., gap maps) that indicate the types of variation explored to date
- Rapid and updated meta-analyses and meta-regressions, as data become available

Ultimately, web-hosting and statistical software that facilitates these methods will also be required, particularly in countries with limited research infrastructure.

Coordination Infrastructure

No single entity could coordinate this long list of activities. Instead, three types of coordination that will be needed.

An overall coordinating center. This is the heart of the infrastructure. The international coordinating center organizes activity in all of the participating sites or countries, facilitates agreement on the shared research protocol, provides the materials necessary to conduct the study and collect data, trains the researchers who will carry out the studies, monitors the research process (including quality control), and receives, cleans, analyzes, and synthesizes the data.

A coordinating center is essential in international studies, where countries have different languages, operate in different time zones, have different school calendars, and organize their schools differently. The center's main function is administrative. It supports the study sites and facilitates communication and governance across sites or countries.

The coordinating center will not only oversee preparation of overall reports, it will also support the preparation of site-specific reports so that countries can understand and use the findings from their local contexts.

A cross-site or cross-country coordinating or governing body. The study protocol must be congenial to all of the countries involved, and they all must be committed to it. A cross-site coordinating body can facilitate buy-in and ensure that the protocol is consistent with the norms and cultures of the participants, so that no one country dominates the study. The group will include representatives of each country, and its primary purpose will be to advise or make policy rather than deal with practical matters, which will be handled by technical advisors from the coordinating center.

A site or country point of contact. As a practical matter, in a large study, it is useful to have a point of contact at every site or cluster of sites. In international studies, a country coordinator is essential, not only as a point of contact for distributing and receiving study materials, but also as a part of the quality assurance process. This point of contact will broker communication between the coordinating center and the research sites, recruit research sites, arrange training of local research staff, and troubleshoot the study's functioning.

Planning a Series of Studies

The research infrastructure's purpose would be to coordinate and align data collection and analyses across studies. In this section, we examine the difficulties that need to be addressed, focusing specifically on the teacher mindset intervention as an example.

Models for Analysis Need to Be Specified

A study of this type seeks not only to understand how well an intervention works on average,

but also the degree to which the effect varies, and how the effect depends on other characteristics of schools and students. Understanding this variation is key to building a theory about the mechanisms through which such an intervention may improve student outcomes.

To accomplish this, three sets of parameters must be estimated: the average treatment effect; variation in average treatment effects both within and across study sites, and the extent to which this variation can be explained by covariates (potential moderators). These parameters can be estimated using meta-analyses, particularly those focused on replication studies (e.g., [8,9]), and on exploring heterogeneity[7,10]. This formulation suggests that each individual study would need to provide estimates of its own average treatment effect, subgroup average treatment effects (based on defined moderators), and within-study moderator analyses (from models simultaneously adjusting for all moderators of focus). Working backward—from the combined, global model to the site-specific local models—ensures that the right data are collected, in the right samples, and measured in the same way, thus allowing researchers to answer their global questions.

Populations and Samples Need Coordination

If a growth mindset intervention's effects are likely to vary across students, classrooms, and schools, then this has implications for both the population and the sample that are included. For example, in a community previously exposed to a strong growth mindset culture, the intervention's effects would likely differ from those in a community without such exposure. Given that such a classroom culture intervention could have important global impacts, the sample population should be as broad as possible. In practice, that means specifying a series of studies on a common intervention, distributed across the globe. Sampling would thus occur in two stages.

First, countries, cities, and locales must be selected. Because both culture and school organization vary from country to country, defining aspects of the sampling frame will need different interpretations. This problem has long vexed comparative studies of education, such as those conducted by the International Association for the Evaluation of Educational Achievement and the Organisation for Economic Co-operation and Development[11–13]. For example, countries assign children to grades at different ages, and they have different grade systems and different degrees of differentiation among schools. Materials must be prepared in different languages and equated across language groups—not just from country to country but even within countries, many of which have several languages of instruction.

Second, in each population, a sample of schools must be recruited into the study. By far the most common approach in education field experiments is to include schools that are nearby to the researcher and easy to recruit [3,4]. But this convenience sampling is far from ideal; it can produce samples that are quite different from the target population. The simplest alternative is to randomly

select schools from the population to be involved in the study. Here stratified multistage cluster sampling may be the most feasible technique, as it accounts for the natural clustering of schools in school districts and allows for the incorporation of costs and other constraints[14,15]. This approach is ideal for estimating the population average treatment effect and variation in effects across schools.

If we also want to study how effects differ across subgroups, we need more complex sampling designs. For example, if one subgroup makes up only a small share of the population, it will need to be over-sampled[1] in order to produce enough statistical power to estimate the intervention's effect on that subgroup well. The situation becomes even more complicated when the study includes multiple moderators. Ultimately, such unequal sampling can affect the precision of the average effect estimate. As an example, the NSLM pre-specified hypotheses regarding moderators and built these moderators into the study design using this over-sampling approach, but then used weights to recover a population average treatment effect[7]. More generally, when multiple possible moderators are pre-specified, the problem can be approached using principles of optimal design for response surface models[10].

Overall, if we want to understand how the treatment effect varies across these contextual and school conditions, the countries and samples included in the study must be heterogeneous. For example, to understand whether the treatment effect is larger or smaller in countries with more or less inequality, our suite of studies will need to include at least one country with high inequality and one with low inequality.

Measures Need to Be Developed

One of the major limitations of existing systematic reviews and meta-analyses as an approach to studying heterogeneity is that studies rarely use the same measures. This problem permeates all parts of the study, including measures of context, moderators, mediators, outcomes, implementation, and even the intervention components themselves. The major benefits of coordinating and aligning these measures across studies include the ability to accumulate knowledge faster, to study variation across contexts, and to go beyond the usual suspects (e.g. age, gender, or race/ethnicity).

Intervention harmonization. In a single study, an intervention needs to be clearly and specifically defined so that all participants receive the same intervention. This issue becomes more complex in a broad, multi-site study. That is, does it make sense to provide exactly the same intervention in widely different contexts? For example, an intervention study conducted in a number of languages may need different cultural references in each language, and so on.

One possibility would be to broadly define the intervention as a fixed set of options for teachers (or study designers) to choose from. Another would be to develop several versions of the intervention

[1]That is, the sample would need to include a greater proportion of this subgroup than would be found in the general population.

and randomize which ones are used in different settings, as a factor to be studied as well. In either case, we would need to develop a measure of the strength and dosage of the intervention.

Implementation quality. Once a group of schools and teachers has been chosen and randomized to receive the teacher mindset intervention, it is likely that not all of them will implement it fully. Thus, beyond measures of the intervention itself, we would need measures of implementation, including both quantity (e.g., the number of lessons attended) and quality (e.g., how well those lessons are implemented).

Outcome measures In the end, a teacher mindset intervention aims to improve student outcomes. But to meet this goal, it must first change classroom culture. For the intervention designers, this raises two questions: How will classroom culture be measured? And how will data on it be collected?

Let's take a look at data collection. Here we need to consider both the way data will be collected and the sample sizes required. For example, one way to collect data would be to ask students to report their perceptions of the culture, including the attitudes and behaviors that their teachers exhibit. We would have to determine how many students would be needed to complete such surveys, and how often the surveys should be administered. Another possibility would be to have an external observer code classroom culture, perhaps by using a protocol. Here again, we need to know how many observation sessions would be necessary. Many well-developed technical guidelines (both psychometric and statistical) could help us create dependable measures of school and classroom culture (e.g., [16,17]). These issues are discussed in depth in a companion paper in this series[18].

Moderators. In the NSLM, the effect of a student-level intervention was moderated by classroom and school characteristics. Thus the effect of a classroom intervention on student outcomes may itself be moderated by features of the school, including the school culture.

Conversations with our partners in the teacher mindset study have suggested several moderators that may be important to guide sampling decisions. Sources of variation may include cultural belief systems, discrimination, degree and type of racial bias and stereotyping, and degree of inequality (as measured, e.g., by Gini coefficients). Moderators at the school level might include school type, urbanicity, teacher training, student grade levels, and refugee status.

To explore and test hypotheses about these moderators, however, we would need to collect data about them. Data collection is costly—in both time and resources—so it will take careful planning to determine the minimum (and maximum) set of moderators to study.

To save costs, existing administrative data could be mined for variables that might moderate the intervention effect. For example, administrative data systems often record student demographics and prior educational outcomes, as well as background characteristics of teachers and schools. Researchers will need to determine the extent to which the variables collected by administrative

data systems map onto the constructs they wish to study. In the United States, for example, whether students receive free or reduced-price lunch often serves as a proxy for their socioeconomic status (SES). SES can be measured in other ways, but those are not recorded in administrative data.

Furthermore, some moderators could be collected across multiple studies, particularly given the global nature of this project. Doing so would help solve another problem that has long troubled the field of meta-analysis [19]: studies do not typically report the same moderators, making it difficult to pool data effectively. That makes it especially important to anticipate and align a minimal set of common moderators across studies.

In particular, the moderator of "school culture" does not appear in administrative data and will need to be operationalized in such a way that data can be feasibly collected. How should we define, measure, and collect data about school culture? For example, school culture could be conceived as:

- *The average culture across classrooms*. Certainly, some schools may engender stronger or weaker classroom cultures on average.
- *The degree of variation in classroom cultures*. A high degree of variation might indicate a school with a weaker collective culture, since students' experiences would vary considerably across classrooms.
- *The degree and type of connectedness between teachers across classrooms*. To understand these factors, we would need to collect data on and measure teacher networks. Several features of such networks might be important to measure, including:
  - The overall degree of connectedness across teachers.
  - Inequity in this connectedness (e.g., one teacher might be central to all networks).
  - The strength of connections between teachers and how connectedness varies across pairs of teachers.

We would need to explore each of these options, in terms of both their psychometric properties and the feasibility of collecting data about them (also see the discussion in ref.[18], this series).

Planning a Single Study

Now that we have outlined the goals for a global suite of studies, let us focus on what it would take to develop the methodology for a single study.

Keep in mind that we anticipate that studies conducted in different countries and samples may differ from one another in many ways. That is, in one country or region, one kind of design may be preferable, while in others a different design may be possible. Given the scope of this project, researchers will need to be flexible about study design and goals at the local level, though they will need to balance local needs against the needs of the combined global study.

Refine the Questions of Focus

To structure this problem statistically, the research team will need to determine which populations, interventions, comparisons, outcomes, and subgroups to include in any individual study:

- **Population**: Who will the study focus on? What are the inclusion/exclusion criteria? What do we know about this population at the study's outset?
- **Intervention**: What are the components of the intervention and what is needed to implement it well?
- **Comparison**: What is the comparison condition? If it is business-as-usual, what do we already know about it? What data will be collected?
- **Outcomes**: How will classroom and student outcomes be measured?
- **Subgroups/Moderators**: How might intervention effects vary in relation to individual, classroom, and school moderators? What hypotheses do we have about subgroups? How will these subgroups be measured and identified?

The study will operate in the real world, thus facing constraints in any or all of these categories, which will ideally be identified from the beginning. For example, we may face constraints on the segments of the population that can be sampled, the dosage possible for the intervention, the types of comparison conditions that can be included, and the types of measurements that are feasible for important outcomes and moderators.

Determine the Study Design

The studies will all take place in schools and will all involve interventions focused on teachers, but two different experimental designs are commonly used. These designs are similar in that they both require recruiting schools and randomizing groups to the intervention (or a comparison). They differ, however, in which unit is randomized. In Table 1 we compare these two designs, which we then describe in detail below.

Table 1. Two Common Research Designs

Design	Recruited	Randomized	Outcomes
Cluster Randomized Trial (CRT)	Schools	Schools	Students
Multi-site cluster randomized trial (MSCRT)	Schools	Classrooms / Teachers	Students

Note: Outcomes at the school or teacher level are often considered as well, though they are typically considered as mediators.

The CRT. By far the most common design in educational evaluations is the *cluster randomized trial* (CRT). In its most common form, schools are recruited to be in the study and then are randomly

assigned to the intervention or comparison group. Within the school, the intervention is delivered to everyone taking part in the study, via teachers and classrooms, or directly to students. A defining feature of this design is that everyone in a given school who is part of the study receives the intervention (or not, if the school is assigned to the comparison group). This is often ideal for both recruitment and implementation.

A potential problem for CRTs is the degree to which students are clustered into schools with other, similar students (as opposed to being randomly dispersed across schools). For example, since schools are found in communities, and communities differ in terms of demographic composition and resources, schools often differ, on average, in terms of these same demographics and resources, as well as student outcomes (e.g., test scores). As a result of this clustering, the CRT can require large total sample sizes in order to garner precise estimates of treatment effects.

The MSCRT. In a *multi-site cluster randomized trial* (MSCRT), after schools have been recruited to the study, classrooms or teachers in each school are randomly assigned to the intervention or comparison group. Thus within each school, some classrooms or teachers receive the intervention while others receive a comparison condition (or continue with business as usual). The sample sizes needed for an MSCRT are an order of magnitude smaller than those needed for a CRT.

Power Analysis – Final

	Effect Size = 0.10		Effect Size = 0.20	
	CRT	MSCRT	CRT	MSCRT
	204 schools required	54 schools required	50 schools required	13 schools required
	4 teachers/ classrooms per school	4 teachers/ classrooms per school	4 teachers/ classrooms per school	4 teachers/ classrooms per school
	20 students per teacher/classroom	20 students per teacher/classroom	20 students per teacher/classroom	20 students per teacher/classroom

Notes: Calculations using Powerup (Dong & Maynard, 2019); Other design parameter assumptions are (1) Intra-class-correlation (ICC) of school-level – 0.17; teacher/classroom-level – 0.12; (2) R-Squared – 0.85; (3) Alpha – 0.05; (4) Power = 0.80; Even with moderate to high contamination levels (20-50%), statistical power is maximized in MSCRT designs (Rhoads, 2011;2016).

A potential problem is that some teachers may share the intervention with comparison group teachers (and thus classrooms) in the same school, thus reducing the treatment contrast. This is called *contamination*, and it can lead to underestimating the effect of the intervention. However, a great benefit of this design is that instead of estimating only an average treatment effect across sites, researchers can now estimate site-specific treatment impacts, allowing differences in outcomes to be quantified. Yet because students may be differentially sorted into classrooms (e.g., parents may advocate for certain teachers), this design also involves a degree of clustering by classroom or teacher, which can make the site-specific impacts noisy compared to student-directed intervention studies like the NSLM[6].

Choosing between the designs. From the standpoint of statistical precision, the MSCRT design is ideal for two reasons. First, because both the intervention and comparison groups are included in any given school, the school effects cancel out, leading to a more precise estimate of the average treatment effect (for a study of the same size). Second, this design allows an average treatment effect to be estimated directly from each school, thus permitting straightforward estimation both of the average and of the degree of variation in intervention effects across schools.

On the other hand, the MSCRT design is problematic if the intervention can be readily (and, perhaps, ideally) shared across classrooms. In this case, the comparison group teachers may begin to implement parts of the intervention in their own classes, thus reducing the differences between the two and therefore the estimated treatment effect. For this reason, the CRT design may have advantages. However, this design reduces precision and does not allow for school-specific treatment effects (and thus variation across such effects) to be estimated. And recent work suggests that an MSCRT is still has greater statistical power even if the comparison condition experiences considerable contamination [20,21].

A possible compromise is to consider contamination as signal rather than noise. By this we mean designing a study to understand the degree of contamination that occurs. One way to do so would be to vary the proportion of teachers within schools who receive the intervention. At the extremes (none or all), a portion of the study will effectively be a CRT, while a proportion in the middle (one-half) reflects a standard MSCRT. By manipulating the proportion of teachers who receive the intervention, the degree of contamination can itself be studied. Methods and studies of this type are not common in education, though interest in this area is increasing in other fields [22,23].

Develop an Analysis Plan

Beyond choosing the optimal study design, researchers need a plan for how each of the study parameters will be estimated. A few approaches are possible; we focus on two of them here. Ideally, an

analysis plan for each site should be pre-registered and principles of open science should be followed.

Estimating the average effect and variation. In both the CRT and MSCRT designs, students are nested in teachers, who are themselves nested in schools. This nesting can be considered using a multilevel model. In a CRT, this model will enable estimation of the average treatment effect across schools. In an MSCRT, this model will also allow for estimation of the variation in treatment effects across schools (since each school has both intervention and comparison teachers).

Estimating contamination. As suggested above, in an MSCRT, it is possible to randomize different proportions of teachers to the intervention versus comparison group across schools. For example, in one school, 90% of teachers may be randomly assigned to the intervention, while in another, 50% are assigned to treatment. By randomly varying the proportion assigned to treatment (either on purpose or due to random variation), contamination (or "spillover") effects can be estimated. This can help us understand the "stickiness" of the intervention (e.g.,[22,23]).

Estimating moderator effects. The simplest approach to estimating and testing hypotheses regarding moderators is to use a multilevel model. In this model, each possible moderator is included as both a main effect and in an interaction term with the treatment group indicator. The problem here is that when many possible moderators are explored and tested, some of them will likely turn out to be statistically significant just by chance.

An alternative strategy is to use Bayesian nonparametric models, particularly those based on regression trees[24]. Richard Hahn and colleagues [25] suggest relaxing the additive assumptions of multilevel linear models, thus allowing researchers to estimate treatment effect moderation that incorporates nonlinearities and higher-order interactions without pre-specification. They introduce a parameterization of these models that allows for separate specification of control variables and potential effect moderators, which was extended to multilevel settings by David Yeager and colleagues [6]. This model is very similar to the multilevel linear models presented above, but it replaces linear models for the effects of control variables and moderators with generic nonlinear functions.

Although these Bayesian, machine-learning methods sound complicated and unfamiliar, they actually simplify the analysis task in two important ways. First, researchers don't have to choose from among complex functional forms of interacting moderators. All you have to do is choose the moderators and then let the machine decide how to use them, informed by a conservative algorithm that avoids over-doing it. Second, researchers don't have to fit and re-fit the model many times to find out where the treatment worked and where it didn't, as in a classical analysis. They can fit the Bayesian model once, draw from the posterior distribution, and then summarize the posterior. This makes it easier to find out where the intervention had meaningful effects, without fooling ourselves by chasing statistical significance.

Even with this more trustworthy Bayesian approach, we should take care in interpretating

moderator analyses[26]. In a randomized trial, the average treatment effect is *causal*. Similarly, the average treatment effects within sub-groups (values of the moderator) are also causal. But the difference between subgroup average treatment effects is merely observed (measured, not manipulated), and thus not necessarily causal. Just because a moderator effect is observed does not necessarily mean that manipulation of the moderator will produce the same increased (or decreased) treatment effect. That is because the observed moderator may be confounded with other, unobserved variables that moderate the effects of the treatment.

Determine the Optimal Sample Size

Based on the research design and analysis plan selected, specific hypothesis tests should be determined before the study begins. For example, it is common to test whether the true average treatment effect is zero or not (this is the basis for *statistical significance*). Specifying a hypothesis test also requires specifying the criteria through which decisions will be made based on the findings (e.g., the effect is statistically significant if the p-value is < 0.05). Here it is important to consider statistical power—the ability to detect that a specified treatment effect exists given the sample size included in the study. Typically, power is set to 80%. When Bayesian methods are used, the question is not how much data are needed for significance, but rather how much data would be needed, given a distribution of possible effects, to shift the what we now believe about the effect size to a pre-defined extent.

Power analysis tools are widely available for both the CRT and MSCRT designs and for testing hypotheses regarding the average treatment effect and variation in treatment effects across schools. In these designs, the statistical power is, to varying degrees, a function of design parameters, including the effect size, total number of schools, teachers, and students, as well as the degree of clustering. Power analyses for moderators are also available in some software, though typically limited to dichotomous variables that are evenly divided between subgroups [27]. Though moderator analyses are well understood, the details of the effects on design sensitivity depend on the design. They are somewhat different, for example, in CRTs than in MSCRTs. This is why it is often preferable to use simulation-based methods (e.g. generating synthetic datasets using defined parameters) for power-analysis in complex studies.

We can make some important generalizations, however. The power of a test of a moderator depends strongly on the level where the moderator occurs. Power is greatest for moderators at levels lower than the level at which treatment is assigned (e.g., the individual or classroom level if treatment is assigned at the school level). Power for tests of moderators is also affected by the heterogeneity of the moderators in the sample included in the study. For example, in a sample with half urban and half rural schools, the comparison of treatment effects across these subgroups has more statistical power

than if the sample included one-quarter urban and three-quarters rural schools[7]. A corollary is that power for moderators is lower at the tails of the distribution of a moderator, such as very low-income or very high-income schools, since there are fewer schools in those groups. Thus, optimal designs and properties of these designs are affected not only by the level of randomization and the level at which the moderator occurs, but also by characteristics of the sample.

Finally, the optimal sample size and study design for a test of the average treatment effect typically differs from the optimal design for tests of heterogeneity and for tests of moderators. For example, when testing hypotheses about the average treatment effect, the total number of clusters (schools) matters more than the number of teachers or students in each school. In contrast, when testing hypotheses about variation in treatment effects across schools, the number of students within each school matters more. Similarly, balanced designs—e.g., with half of participants in treatment—are optimal for the average, but not for testing hypotheses about spillover. When testing moderator relationships, it may be necessary to oversample certain subgroups to improve power. For instance, if one main question concerns moderation by the community's income, then perhaps we should over-sample the very high and very low-income communities. This then requires weighting adjustments when testing hypotheses about the average, but this weighting will also reduce power. It is thus important that all of the hypotheses of interest are considered when determining the final research design and sample size, so as to reduce surprises at the analysis stage.

Conclusion

In this paper, we have outlined the infrastructure, coordination, and study designs required to conduct a global suite of studies. We have proposed going beyond the current field's current approach to research synthesis, which usually involves aggregating *ad hoc* studies with different measures, designs, and moderators, and hoping that pooling their information leads to meaningful insights. It would truly be revolutionary to prospectively design a global set of studies for a heterogeneity-informed meta-analysis. As we have shown, if studies are planned and designed carefully, together they will allow us to develop deep theory at the same time as they provide critical information regarding for whom, where, and under what conditions such an intervention can improve student outcomes.

We have focused this paper on a teacher mindset intervention. But the infrastructure and coordination described here would have benefits far beyond studies of mindset interventions. Once in place, such infrastructure could be used to study any educational intervention. With its diversity of locations and contexts, this infrastructure would allow potentially promising interventions to move from development to testing at scale faster and more efficiently, ultimately improving outcomes for students and communities around the world years sooner than is currently possible.

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GLOBAL MINDSET — INITIATIVE —

Discussion Paper on Global Mindset Initiative Working Paper: "Teacher Mindsets and Practices"

By Mary Murphy, Stephanie Fryberg, Laura Brady, Elizabeth Canning, Cameron Hecht

Thomas F. Luschei, Claremont Graduate University
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Murphy et al.'s paper on teacher mindsets and practices presents a comprehensive review and analysis of research from multiple fields to lay the foundation for an ambitious research agenda to create and sustain growth mindset in schools and classrooms across the globe. The authors successfully distill the reviewed research into a compelling conceptual model and concrete lessons for practice, arguing for a whole classroom cultural approach "focused on teachers as the primary culture creators of their local classroom cultures" (p. 4). In this discussion paper, we review the key highlights and contributions of the paper, relate the paper to the work of Colombia's *Fundación Escuela Nueva*, provide suggestions for future research, and discuss implications of the paper for educational policy and practice.

Paper Highlights and Contributions

- The paper is very successful in reviewing and bringing together literature from multiple disciplines, making diverse studies and approaches speak to each other to provide a starting point for an ambitious global research initiative.
- Table 1 provides an excellent synthesis of concrete teacher growth mindset practices that will be very helpful in communicating current research to educational practitioners and stakeholders charged with implementing classroom-, school-, and system-level changes.
- The paper offers a comprehensive set of recommendations for future research and acknowledges how local context and culture may influence the adoption of global mindset approaches across different settings.

Relating the Paper to the Work of the Fundación Escuela Nueva

- The paper's initial description of a growth mindset classroom offers striking parallels to the *Escuela Nueva* classroom, which consists of children of multiple grades learning in a child-centered, collaborative, and flexible classroom supported by a teacher/facilitator. For example, Murphy et al. anticipate that in a growth mindset classroom, "cooperation and collaboration supersede competition, as students look out for one another and ensure no one is left behind in their learning" (p. 1). The foundation of *Escuela Nueva* is cooperative and collaborative learning that has been linked to positive academic and non-cognitive student outcomes, as well as improved social relations among students in one of the most violent regions of Colombia[1,2]. Another key parallel is Murphy et al.'s depiction of continual learning and growth: "when students make mistakes or don't understand a new concept, they do not experience shame or attempt to hide their confusion. Instead, they are galvanized to figure it out and learn together" (p. 1). Under *Escuela Nueva's* approach to flexible promotion, students do not fail units, classes,

or grade levels. Instead, they work individually or in small groups at their own pace until they are ready to transition to the next set of learning activities[3].

- One key lesson from the history of *Escuela Nueva* is the hard work required to introduce an educational reform that radically breaks with traditional pedagogical approaches. Classroom culture in many Latin American countries is hierarchical, teacher-centered, and rigid, not to mention often embedded with fixed mindset assumptions. When it appeared in the 1970s in Colombia, *Escuela Nueva* introduced a radical, student-centered approach to a very teacher-centered instructional culture. One key to *Escuela Nueva's* success was to start from the bottom up, recruiting excellent and enthusiastic teachers, demonstrating the model's effectiveness through demonstration schools, and then scaling up with support from the Ministry of Education[3].
- Although the paper does not provide extensive discussion of teacher training approaches, three lessons from the *Escuela Nueva* training model are worth noting:
  1. Teachers are best convinced to adopt a new practice when they witness its success in action; *Escuela Nueva* accomplished this through the use of demonstration schools where the model had been implemented successfully.
  2. Teachers must receive training using the approach that they will implement in the classroom; that is, if teachers are expected to incorporate growth mindset approaches, they must experience such approaches as they learn fundamental concepts and strategies.
  3. After receiving training, teachers—especially teachers in remote rural schools—must not be left alone to fend for themselves. They must receive support from colleagues and school leaders. *Escuela Nueva* used teacher learning circles or *microcenters* that brought teachers together regularly to share ideas and collaborate to confront educational challenges they faced in the classroom[3].

Suggestions for Future Research

- Although the growth mindset model presented by the authors (Figure 1) includes classroom, school/district, regional, and national culture, the paper primarily focuses on classroom culture. However, one can imagine that many stakeholders might resist the implementation of GMS, including school principals facing accountability and testing pressures, parents wanting special enrichment for their children, or colleagues who consider GMS approaches to be unrealistic. Future research must examine the role of school leaders and other actors and their role in supporting classroom-level growth mindset approaches. The role of school leaders in school improvement and reform is particularly important[4,5].
- The paper mentions a recent study by the OECD[6], which finds that "across a wide range of

countries, students who reported that their teachers helped them with their learning, provided extra help to struggling students, continued teaching until students understood, and showed an interest in students' learning were 4-5 percentage points more likely to report having growth mindset beliefs. This finding suggests the intriguing possibility that many teaching practices that support students' growth mindsets may be consistent across many cultural contexts" (p. 25). A pressing area for future research is to examine variability in these growth mindset practices across countries, and to explain this variability (along with variability in growth mindset beliefs) in terms of national or local policy or social contexts. For example, the 2021 OECD report found that less inclusive education systems have lower shares of students with GMS (p. 45)[6]. What other education system or contextual features help to explain variability in growth mindset beliefs and approaches?

- In addition to the recent OECD study of growth mindset, earlier cross-national studies may help to provide further context related to the challenges of instilling growth mindset beliefs among teachers globally. For example, the 2012 Teacher Education Study in Mathematics (TEDS-M), which examined the preparation, knowledge, and beliefs of future teachers across 17 national education systems, found that future teachers and teacher educators in several countries believed that not all children can or will succeed in mathematics. Further, countries where future teachers and teacher educators held this fixed ability belief tended to represent lower-income contexts, including Botswana, Georgia, the Philippines, and Thailand[7]. These results again emphasize the importance of national context and its impact on growth mindset beliefs; they also suggest that there may be differences in teachers' growth mindset beliefs across higher- and lower-income countries.

Implications for Educational Practice and Policy

- Although the success of growth mindset will ultimately rest on the beliefs and actions of classroom teachers, the broader education policy context will also influence the extent to which teachers are permitted or empowered to undertake related instructional changes in their classrooms. The paper seems to assume a context like Finland, where teachers are well-trained, autonomous, and empowered professionals with broad powers to implement instructional changes8. However, recent research demonstrates that teachers in many countries (including Finland) are losing authority over classroom-level decisions. At the same time, school principals have gained decision making authority over curriculum and instruction, which again underscores the importance of school leaders9. For growth mindset interventions to be successful, actors and institutions at multiple levels of the education system must support accompanying classroom- and school-level changes. This will require a global campaign

directed toward ministries of education, state or regional secretariats, and local districts. Such a campaign will also need to recognize the degree of system centralization or decentralization to identify the proper level to address appeals for support in the global growth mindset effort.

Conclusion

- Murphy et al.'s paper on teacher mindsets and practices provides an essential point of departure for an exciting, ambitious, and long-term research agenda. The broad scope of their review speaks to a wide diversity of researchers and practitioners, while offering space to propose new research questions and implications for practice. From our perspective, these new directions include the important role of school leaders, lessons from Escuela Nueva's global educational successes, and further consideration of local and national contexts.

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GLOBAL MINDSET
— INITIATIVE —

Comments on "Global Mindset Initiative Working Paper: Designing an Intervention to Motivate Growth Mindset-Supportive Teaching Practices"

Eric Bettinger and Mari Rege

Teachers matter. An extensive value-added literature in education and economics has demonstrated that teachers vary extensively in the extent to which they succeed in scaffolding their students' development and learning (e.g.,[1–3]). This literature measures teacher effectiveness by comparing their students' improvements in standardized test scores over the school year, to the improvements of other students in the same grade at the same school. The evidence suggests that improving teacher effectiveness by one standard deviation seems to increase performance in reading by 13 percent and in math by 17 percent of a standard deviation[4]. Moreover, a good teacher is important for students' social and emotional development[5,6], the effects seem to last into adulthood[5,7] and can even benefit the future peers of affected students[8].

Despite extensive evidence on variation in teacher value-added, we have limited understanding of *why* some teachers are more effective in promoting human capital than others, even at the same school. Interestingly, observable characteristics such as teacher education, tenure (beyond the very first years), gender, and IQ do not predict value added consistently across studies[1,9,10]. There is some evidence that the teachers' academic performance in college and the selectivity of their college is predictive of some value-added measures[10]. However, most of the variation in teachers' value added remains unexplained.

The quest for better understanding the underlying mechanisms for variation in teacher quality, has directed several scholars towards studying the teacher's facilitation of process quality and how this is linked to student learning. Process quality represents the direct experiences for children, and includes factors such as the sensitivity and responsiveness of teachers, interactions with teachers and peers and the pedagogical approaches and material. An often-used measure of process quality is CLASS[11], which measures three aspects of teacher practice: instructional support, emotional support and classroom organization. Several papers demonstrate that children exposed to teachers with higher CLASS scores have higher teacher value added scores (e.g., [12,13]). A recent study by Araujo et al.[14] provides particularly convincing evidence. Based on videos from kindergarten classrooms, this study measures process quality using CLASS. By utilizing random classroom assignment for identification, the study provides convincing evidence that these teachers' practices are strong predictors of the teachers' value-added estimators. Another relevant study is Thijssen et al. (in press) who demonstrate, also by using random classroom assignment, that teachers' effort to build relationships with their students is important for student learning. Moreover, Bettinger et al. (in press) demonstrate that teachers' use of growth mindset practices in middle school are strong predictors of their students' choosing advanced math in high school.

As we gain more insights into what classroom practices effectively scaffold students' learning and development, the next step is to better understand how to induce teachers to adapt these practices and whether these changes affect student learning. The challenge of doing this in a scalable way further complicates this endeavor. To this end "Global Mindset Initiative Working Paper: Designing an Intervention to Motivate Growth Mindset-Supportive Teaching Practices" is a useful resource. It gives an excellent introduction to relevant literature for designing an intervention to change teacher practices and provides constructive suggestions for tools aimed at changing teachers' practice.

The article starts out by recognizing that the typical approach for changing teachers' practices, using various form of teacher professional development training, has proven ineffective. Even if teachers learn how they should change their practice, they still fail to do so. This finding is echoed in education and economics, which has consistently failed to find meaningful impacts of professional development[15–17]. The paper then discusses why it is so hard for teachers to change their practice. It highlights several so-called *restraining forces*. Several of these forces are common for the whole profession or the whole school, such as the lack of resources or too high demands on teachers' time. We want to emphasize that such restraining forces, operating at the school or school district level, cannot explain the large variation in value-added across teachers within the same school. It is important to recognize that in almost every school district and at almost every school there are some excellent classrooms.

As such the restraining forcers that operate on the individual level seems more promising when discussing teacher behavioral change. Here the paper discusses two well-known human biases that may hinder behavioral change: 1) individuals' time inconsistent preferences which lead to procrastination of behaviors that requires immediate behavior and 2) individuals' tendencies to rely on routines and habits. Moreover, it discusses several potentially useful intervention tools that may address these teacher biases such as implementation plans, timely reminders and feedback from the students. Recent work by Oreopoulos and Petronijevic[18] uses experimental evidence to demonstrate that study plans among students do not improve student performance; however, the use of commitment devices and reminders among teachers may have promise. This is because of both the incentives for teachers to act on such information, and the potential of the "train-the-trainer" type interventions to allow for cost-effective scaling.

Further, systemizing the teacher training on growth mindset can provide important continuity and improvements. Since growth mindset has been introduced, it has almost become "ubiquitous" in the way in which students, teachers, and administrators invoke its title. In some settings, any student-

facing intervention or encouragement is referred to as being "growth mindset" even when the core element of growth mindset: a belief that intelligence is malleable – may be absent from the underlying intervention[19]. Teacher facing resources can only strengthen the relationship between true growth mindset and its practical implementation.

As with any new resource, we encourage further testing and monitoring. While the fundamental problems and approaches in the resource are theoretically motivated and empirically supported, any effort at scaling systemic changes could introduce new complications and alter the underlying instructional environment. Moreover, further testing and monitoring may provide additional insights into ways to improve the existing training and information on other unique challenges (and potential solutions). Such testing and monitoring can also provide important information on the long-run effects of these interventions. Hence, interventions that engage teachers and promote changes in teachers' practice are a very promising research agenda.

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GLOBAL MINDSET — INITIATIVE —

Global Mindset Initiative Working Paper 2: Designing and Intervention to Motivate Growth Mindset-Supportive Teaching Practices - Christopher Bryan et al.

Ron Berger and Kristina Kyles-Smith

As practitioners based in the U.S. with over 50 years of combined work leading professional learning for teachers, we were struck by how much we believe this paper gets right and resonates with our experience. Our lens is limited by our U.S. perspective but is inclusive in its national overview, informed by a wide range of work in urban, rural, and suburban schools and districts, particularly with historically marginalized communities. We push the authors of this working paper in a few areas but we feel that the paper is spot on in its focus and in the particular strategies it elevates.

Most important to us in the merits of this paper is its adoption of an asset-based lens for teachers. In the U.S. there is a pernicious irony in our national embrace of the merit of using an asset-based, growth mindset approach to students while we typically use a deficit-based, fixed mindset approach to teachers. We believe, as the authors of the paper suggest, that most people enter the teaching profession with a noble purpose—to make a difference in children's lives. In our experience the most effective professional transformation for teachers taps into the virtuous side of teachers' motivation, respects their experience, and revitalizes their positive values. We also agree with the authors that few enter the teaching profession for money or status, and using incentives such as merit pay or job evaluation to motivate teacher change can feel manipulative and demeaning.

The asset-based vision in the paper is evident in what it prioritizes for practices, emphasizing teacher agency and empowerment, and using common positive values as an engine for teacher growth. This aligns with our personal experience that teacher habits are hard to change; that systemic constraints bind teachers into limitations that distance them from their passions; and that changing habits is most effectively tied to a process of liberation from constraints, collaboration, and affirmation of why they got into the profession in the first place. The paper suggests including teachers in designing, implementing, and improving interventions to practice; uncovering shared values among teachers that can be connected to the use of growth mindset strategies; and using professional learning communities—small collegial continuous improvement groups. All of these strategies align with what we have seen to be most effective in schools..

We also agree with the authors' sharp critique of traditional professional development that is disconnected from context and puts teachers in a passive role of listening and viewing slides. Recent research, such as the TNTP report The Opportunity Myth, makes clear that this type of PD is ineffective, and any teacher can share with you how that perspective aligns with her personal experience. However, we felt that the authors go too far in the paper in dismissing the entire format of PD sessions as irrelevant. In our experience school-based PD sessions can be inspiring and effective when they are done well (e.g., co-planned, co-led, interactive, empowering) and are an essential part of a strong program for teacher growth.

We feel that there is a small disconnect between the opening of the paper and its body. The opening emphasized the need for fiscal and logistical limits on interventions (for equity and scale reasons) and dismissed strategies such as coaching and mentoring as unfeasible. That suggests that we should be seeking a simple, standardized intervention. The paper went on though to endorse personalization and customization to engage teachers and connect to local context, to connect to shared values, and to involve teachers in planning and leading the work—all complex processes that can't be simply plugged in. We believe that changing teacher practice is always complex and personal, and we endorse customization for local context. We also believe that coaching and mentoring should not be off the table because under the right circumstances, with a good toolkit of resources to guide the work, peer support for change in the forms of coaching and mentoring can be very effective.

Our push to the authors is that the paper does not address what we feel is the most important engine for the improvement of teacher practice: Transforming school culture. The authors treat teachers as independent agents rather than as members of a school community that shapes values, norms, and practices. Teachers are siloed in their classrooms and they are at the same time molded by the school's professional culture. When a school genuinely adopts or revitalizes a schoolwide mission and vision with a consonant set of commitments and practices, it is capable of a profound change in teacher habits.

Connections to Our Experience: A Case Study of Two Schools

We believe teacher empowerment is an important engine for a teacher's growth mindset. Empowered teachers empower students. We share examples from two urban school organizations in which a schoolwide culture that cultivated teachers' growth mindset was transformational. One, an historically Black public high school, has existed for over 100 years: the other, a small K-8 network of charter schools, was founded in 2003.

Like many historically Black urban schools, Dunbar High School in Baltimore, MD saw a significant decline in enrollment, academic outcomes, and the retention of its veteran teachers in the 1990s and early 2000s. The district regularly experienced changes in its leadership team, support structures, curricula, and mandates, and teachers were jerked this way and that way by the changes. The school, initially built on the mission of empowering students abused and marginalized by racism in America to become powerful and active citizens, was reduced to just aiming for enough growth in test scores to comply with state requirements. Teachers shifted from collaboration and responsible academic freedom to struggling to keep up with mandates and simply survive. Professional development was

disjointed and a growth mindset was considered a luxury.

The school re-ignited teachers' passion by returning to the basic promises made to the community: To be a world-premier health professions high school that shephered all students, including their renowned student athletes, towards their full potential. Decluttering initiatives and focusing on their shared mission impelled teachers to engage in powerful professional learning cycles collaboratively. The key to improving student outcomes was not introducing more prescriptive interventions but building a galvanizing and inspiring school culture—rooted in the school's powerful historic mission— and making space for teachers to continuously improve their practice. To do this, the school embarked on improving conditions for teachers to collaborate and learn from each other—co-locating departments in the building, changing the schedule to allow for increased teacher shared planning time, and building collaboration norms and protocols to support teachers in leveraging each other and maximize shared time.

The incentive to improve did not come from external motivations but instead from improved working and learning conditions for teachers. After implementing a schedule that included more time for teacher collaboration during the day, teacher groups were inspired to meet after school and on weekends. One group of science teachers created a planning group that met at a local university on Sunday evenings. Additionally, participation in school activities increased, and more teachers attended student athletic games, organized evening parent events, started clubs, and even got involved in advocacy work.

As a much newer set of schools, Two Rivers Public Charter Schools in Washington, D.C. is a nationally-renowned charter organization that includes three schools and a professional development institute. It has a strong reputation for academic success. Since its founding it has championed the same compelling mission—providing students with community-based and inquiry-driven whole-child education. The school's diverse community of families note the powerful student-teacher relationships and the joy in learning. Teachers speak emphatically about the mission as a driving factor for joining the staff and remaining committed to professional development. And, significantly, the school is unusual in the growth mindset of its teachers.

Two Rivers invests heavily in continually reinforcing its mission through teacher-led learning. Teachers lead professional development cycles for small teams. Every August, the organization embarks upon four weeks of professional development led by staff members, school principals, and the executive director. That learning is done in a way that communicates that everyone is a lead learner, can

continually improve, and that they are there to grow and learn together as colleagues. This culture carries over into the classroom, where teachers provide students with the ability to revise their work, improving through multiple drafts, using kind, specific, and helpful peer critique. Growth mindset is at the heart of the school culture: if you are a Two Rivers student, teacher, or leader, this is what you believe and what you practice every day.

These schools are constantly working to improve and to stay on mission. Every day there are threats to their culture and their success. Without continuous stewardship, teachers drift from the values, mission, and goals that unite them. What motivates teachers to persist through complex challenges is the power of their school culture—the environment that affirms their shared purpose and values and supports and impels them to grow together as professionals.

GLOBAL MINDSET — INITIATIVE —

Reflections from the Aga Khan Foundation

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This response to the growth mindset working papers primarily focuses on the first two, on a) growth mindset cultures and teacher practices[1] and b) designing an intervention to motivate growth mindset supportive teaching practices[2]. I adopt a practitioner perspective from implementing educational development programmes in Pakistan and Kenya. In doing so, I refer to three initiatives of the Aga Khan Foundation (AKF) that look at:

- the new Classroom Guide to Creating an Inclusive Learning Environment;
- the Programme to advance Teacher Transformation through values-based education and a pluralistic perspective; and
- the Schools2030 global initiative, which fosters teacher-driven innovations across 1,000 schools to improve holistic learning outcomes at scale.

I pose the question of how these three programmatic interventions might portray the essential role that teachers' growth mindsets, and those of their students, play in advancing quality education in real-world contexts throughout the world. My reflections also raise questions related to points in the working papers and potential research that may be useful in developing country contexts.

AKF's Education Improvement Programme

The goal of the Aga Khan Foundations's (AKF) global education programme is to "equip girls, boys and young adults with the knowledge, skills, attitudes and values to help them interact effectively with the world and contribute to society." In trying to supply what young people need not only to survive and but to thrive in today's uncertain world, AKF emphasizes skills, attitudes, and values alongside academic knowledge throughout the lifelong ladder of learning. Building on expertise developed over the last six decades, AKF recently began three innovative initiatives that can be said to adopt a growth mindset approach, albeit in three different ways through their programmatic approaches. They all start with an underlying belief that teachers and school leaders are at the heart of educational change. AKF works to empower teachers to create positive change that will improve student learning outcomes and address equity issues. I describe these initiatives below, along with questions they raise in relation tt potential new avenues of research on growth mindsets.

AKF's Classroom Guide to Creating an Inclusive Learning Environment

The Classroom Guide to Creating an Inclusive Learning Environment[3] is a new tool that teachers and mentors can use to foster a safer and more learner-friendly environment that includes practical approaches to teacher-led classroom observation and teacher-to-teacher/mentor professional developmental dialogue strategies. The Guide arose from AKF's previous work on the importance of social and emotional skills and effective pedagogies and integrating pluralism and

ethics in our approach to advancing in-service and pre-service professional development support programs for teachers around the world. It draws from on a large body of research suggesting that students'and teachers' personal qualities, also defined as social and emotional skillls, can enhance academic achievement and student well-being[4,5]. This includes the growing evidence that when students experience positive and trusting relationships in the classroom, they demonstrate better achievement in the short and long term, as well as evidence of what makes for an optimal school culture and pedagogy[6–9]. The Guide also complements the World Bank TEACH and COACH measurement toolkits[10].

The guide, now developed into a blended learning tool with videos of teachers from Portugal, Kenya and Pakistan, focuses on two key aspects of teachers' classroom practice: advancing a positive emotional climate and encouraging instructional quality. It offers participants opportunities to reflect across nine dimensions of an inclusive learning enviornment:

1. positive emotional climate;
2. teacher sensitivity;
3. classroom agreements;
4. learning objectives and sequencing;
5. effective facilitation;
6. differentiation;
7. individual and collaborative learning;
8. learning to learn (metacognition); and
9. feedback strategies
10. assessment strategies.

All the themes in the framework suggested by Murphy and colleagues are covered in the Guide.

Each of the dimensions contain a number of descriptors for classroom observation and examples of questions to initiate and sustain a professional dialogue between teacher and mentor. The inclusive classroom environment that the Guide seeks to develop, steeped in a deep belief in the importance of the teacher and the need for positive relationships between the teacher and students, could well be described as one which creates a growth mind-set supportive culture[11,12].

Examples of the descriptors include:

- the teacher gives the students a clear sense of the purpose of the lesson in language they understand, including expected learning outcomes and connections to previous learning.
- the teacher treats all students fairly with respect and value, consistently challenges stereotypes/negative attitudes when they arise, and involves students in exploring and questioning them.
- Students enjoy answering questions without fear of "getting it wrong" and actively ask their

own questions.

- The teacher communicates the highest expectations.
- Students contribute to the development of their own class/school code of conduct. Students uphold the class code of conduct, rarely misbehaving and often suggesting solutions for conflict resolution.
- Students are encouraged to take learning risks and are happy to ask and answer questions, even difficult ones. Students are encouraged to openly talk about their failure in a positive way, and teachers praise their effort, not just the outcomes. Students seek clarification and support when they encounter barriers to learning.
- The teacher provides feedback that focuses on students' effort and attitude and helps to increase confidence, self-efficacy, and self-esteem;
- Assessment strategies are an integral part of the lesson and are used to improve learning, set teaching strategies and set learning targets for students. There are opportunities for student self-assessment and peer assessment and for students to set their own goals.

One question for future research on growth mindset-supportive cultures is how overt we should make the terminology of "a growth mindset" when taking into account contextual and language parameters. The Guide does not refer to "growth mindset" per se. However, it addresses growth mindset implicitly. Is this enough to create the desired effects; that is, improved learning environments, pedagogical practices, and, potentially, student learning outcomes?

A Programme of Teacher Transformation that advances Pluralism and Values-Based Education

AKF's Teacher Transformation for Pluralism/Value-based Education Modules[13] aim to develop pluralistic and ethical dispositions in teachers. They encompass the underlying belief that we each have within us the ability to relate and respond to others with empathy and compassion and embrace diversity. AKF believes that as teachers, we can transform ourselves and the children in our classrooms. However, we cannot truly do this unless we ourselves, as teachers and education system leaders, explore our own biases and how they impact our interactions with others.

The program's four modules focus on exploring

- the self;
- my relationships with others;
- my role as an educator in the classroom, and;
- my skills to integrate values and competencies across the curriculum (under development).

The modules seek to help teachers model and develop eight personal qualities and competencies linked to pluralism and ethics and the curriculum, including 21st century skills such

as: self-awareness and resilience, empathy and open-mindedness, respect for diversity, taking responsibility, relationship building, collaboration, reconciling tensions, and critical thinking and problem-solving. Activities include identifying student strengths that underly negative student behaviors.

The two-day intensive modules (developed with partners, including Dream a Dream in India), build the capacity of teachers and community/youth workers by employing an innovative experiential creative life skills approach that uses ,e.g., art, movement, drama, visualisation and poetry. Importantly, it seeks to do this by creating a supportive community that learns through fun, takes increasingly creative risks, and moves of its comfort zone within a safe learning space. The program was launched in rural and urban schools in Kenya. Working with all the teachers in a school, the program has been able to weaken "restraining forces"—teachers learn to relate with more empathy and work more collaboratively in changing school and classroom cultures. Some of these effects have also been reported in homes and offices. Many teachers state that they have changed personally and professionally in how they relate to others and children, including becoming their more "authentic selves" and removing bias so all children are able to learn more inclusively. This exploratory and creative life skills approach enables teachers to develop a strong growth mindset with which they somehow transform as teachers and in turn are seen to create more inclusive and equitable classroom and school cultures.

Though the modules obviously seek to enable teachers to create growth mindset cultures in schools and classrooms, they lead to key questions for research. Does a growth mind-set programme require a single simple intervention, or a series of continuous, cyclical interventions? Would it be more beneficial for teachers to explore their own mindsets and how they came to be formed more deeply through experiencial and playful learning? Does a growth mindset arise as a result of an intevention or through experiencing it? Would this then not address making individual practices in creating growth mindsets more connected, consistent, and seamless (as expressed by Murphy and colleagues[1]) as teachers develop a more holistic philosophy/belief in the importance of having a growth mindset? Would this allow for a deeper and therefore more sustainable shift from a fixed mindset to a growth mindset with an awareness of the impact this has on students in a classroom? Is the additional expense of a deeper focus on oneself for the sake of developing a growth mindset more beneficial in the end than agrowth mindset intervention within traditional subject-based professional development?

Schools2030

AKF's Schools2030 program seeks to address the low learning outcomes for marginalized children and youth across 10 countries, with a particular focus on key transition years for children: ages 5, 10, and 15. It is a new globally informed, locally rooted 10-year learning improvement platform

working with 1,000 pre-primary, primary, and secondary government schools across 10 countries (Afghanistan, Brazil, India, Kenya, Kyrgyzstan, Pakistan, Portugal, Tajikistan, Tanzania, and Uganda) as an incubator of "what works" to improve learning outcomes for the most marginalized learners.

At the heart of the initiative, Schools2030 believes that educators are design thinkers; it creates new opportunities for teachers to design, implement, measure, and showcase new school-based innovations to understand what works, thereby driving future education policy, practice, and research from the bottom up rather than the top down.

The program rests on a critical question about the future of educational assessment, pedagogical training, and policy planning across the sector: "What's in it for the teacher and the school?" Schools2030 thus flips the traditional model of educational reform from top-down to bottom-up and is aligned with the global movement in educational research that seeks to discover what works to improve learning outcomes and create quality education for all[14,15]. Schools2030 continues to adopt and adapt the tenets of implementation science—the study of how evidence-based programs can be embedded to maximize successful outcomes[16] and draws on a positive deviance approach[17] in the school setting to drive a strength-based, community-driven methodology.

Already, Schools2030 has applied methods and principles from four interwoven, interrelated methodological traditions in educational research:

1. community-based operations research[18];
2. implementation science research[16];
3. the action research approach[19–22]; and
4. the participatory and learning action (PLA) tradition[23–26].

All four approaches place strongly emphasize "local stakeholder participation in problem definition, solution, and implementation"[27] and operationalize what Chambers[28] describes as a 'paradigmatic shift from things to people, from top-down to bottom-up, from standard to diverse, from control to empowerment' (p. 26).

Schools2030 is already generating both qualitative and quantitative evidence about how school stakeholders can best adapt and implement evidence-based solutions to improve learning outcomes for all. For example, Schools2030 has been accepted by the Education and Development Forum (UKFIET) to lead a global symposium about transferring power back to teachers to guide how we go about measuring what matters in quality education; this is just the beginning of what we know is a long journey of empowering teachers and schools themselves to lead sustained change. And Schools2030's Global HCD Toolkit was recently named as a global best practice in design thinking by the Core77 Design Awards (see: https://designawards.core77.com/Design-Education-Initiative/105160/Empowering-Educators-to-Creatively-Solve-Problems-Across-the-Globe). The toolkit was selected from hundreds of submissions from around the world; again, it places teachers at the

heart of redesigning what works to improve learning outcomes for all.

The overall aim of the Schools2030 program is to give educators and school-level stakeholders more agency to reclaim the discourse about "what works" and drive change from the bottom up. At the heart of the Schools2030 approach is the recognition that schools should be the center of social change, not its target. Rarely are school leaders, teachers and students perceived to be reservoirs of innovation, or invited to listen, reflect, and self-discover the wisdom that lies among them. Even rarer are instances where invitation, dialogue and self-discovery lead to community actions and external investments, guided by data that the school collects, processes, and uses to achieve holistic learning outcomes for all[29].

Thus Schools2030 could be said to bring a growth mindset approach to intervention design in its belief that teachers can learn and improve student learning. Schools2030 strongly objects to a teacher-deficit model in education program design, and instead places teacher-driven innovation and empowerment at the heart of achieving the United Nations' Sustainable Development Goal 4 agenda by 2030 (see https://sdgs.un.org/goals/goal4). This is a liberating idea that can release confidence and potential, though it does not explicitly address growth mindset or a specific growth mindset intervention.

The program equips frontline teachers of 5, 10 and 15 year old students by taking them through a human-centred design process that enables them to design stakeholder-focused solutions to problems they have identified as important (thus addressing the weaknesses in teacher professional development identified by Bryan and colleagues). They are taken through a six-step process to assess, design, fund, track, iterate and reiterate, and showcase their solutions, pitching them at national and global levels. The evaluation strategy includes a classroom observation tool as well as student assessments. Over time, it would allow us to identify what makes for more effective teachers and to find tested solutions that work on the ground.

With its focus on equity and holistic learning outcomes, Schools2030 identifies contextually relevant growth mindset practices and materials that teachers themselves have developed, tested, and measured over time. The theory of change behind the initiative is that the culture of a school can be more adaptive, responsive, and innovative by enabling teachers themselves not only to cultivate but to apply a growth mindset to their practices for improving learning environments and outcomes for their children. The culture begins by seeing results. And each year, Schools2030 will provide a unique and exciting opportunity for teachers to showcase the solutions that they designed to local, national, and global decision-makers in education policy, research, and practice. As a result, these 1,000 annual solutions may become one of the best illustrations of growth mindset in action for the teacher profession worldwide. We hope that their solutions will begin to create new, relevant, actionable, and meaningful pedagogical toolkits and materials that may also diversify what works for whom and why,

thus improving learning outcomes by enabling teachers themselves to drive the innovation process from the very beginning.

A General Reflection

In general, growth mindset research should also, as the working papers suggest, consider the differing contexts of teacher status in developing countries where teaching is not a preferred profession, where initial teacher training is theoretical, and where infrastructure and resources are poor. In such circumstances, teachers are the critical force that matters most in children's learning[30,31]. It would be good to reinforce that in any global research, "context matters"[32]. It may be useful to explore how far growth mindset interventions apply or could differ in countries whose cultures are more individualistic or more collectivist, as well as in urban versus rural contexts[33]. In doing so, the research community will need the intellectual humility to create coalitions that authentically include researchers from the global North and South, teachers themselves, and local education decision-makers. This will allow more inclusive, enriched, and contextually relevant perspectives to emerge from this critical field of growth mindset research.

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