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Mind-Set Interventions Are a Scalable Treatment for Academic Underachievement

David Paunesku[1], Gregory M. Walton[1], Carissa Romero[1], Eric N. Smith[1], David S. Yeager[2], and Carol S. Dweck[1]
[1]Stanford University and [2]University of Texas, Austin

Abstract

The efficacy of academic-mind-set interventions has been demonstrated by small-scale, proof-of-concept interventions, generally delivered in person in one school at a time. Whether this approach could be a practical way to raise school achievement on a large scale remains unknown. We therefore delivered brief growth-mind-set and sense-of-purpose interventions through online modules to 1,594 students in 13 geographically diverse high schools. Both interventions were intended to help students persist when they experienced academic difficulty; thus, both were predicted to be most beneficial for poorly performing students. This was the case. Among students at risk of dropping out of high school (one third of the sample), each intervention raised students' semester grade point averages in core academic courses and increased the rate at which students performed satisfactorily in core courses by 6.4 percentage points. We discuss implications for the pipeline from theory to practice and for education reform.

Keywords

academic achievement, motivation, intervention, educational psychology, adolescent development

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Every year, high-quality articles published in the finest journals demonstrate the power of psychological interventions to bring about meaningful change in academic achievement (e.g., J. Aronson, Fried, & Good, 2002; Blackwell, Trzesniewski, & Dweck, 2007; Cohen, Garcia, Purdie-Vaughns, Apfel, & Brzustoski, 2009; Good, Aronson, & Inzlicht, 2003; Harackiewicz, Rozek, Hulleman, & Hyde, 2012; Hulleman & Harackiewicz, 2009; Jamieson, Mendes, Blackstock, & Schmader, 2010; Sherman et al., 2013; Walton & Cohen, 2011; Wilson & Linville, 1982, 1985). Yet a critical limitation of these interventions is they are rarely tested in ways that can be readily scaled up. They often require that researchers be extensively and personally involved at school sites to ensure appropriate delivery of the intervention (see Yeager & Walton, 2011). It is therefore unclear whether any published psychological intervention can move beyond a boutique remedy to raise achievement or close achievement gaps for large numbers of students. In the study reported here, we addressed that issue. We tested, for the first time, whether psychological interventions could practically be deployed to raise academic achievement on a wide-scale.

Our focus is on underperformance in U.S. high schools. Millions of students drop out of high school every year. They tend to be unprepared for either college or the workforce and consequently suffer poorer job prospects, worse health, and higher incarceration rates than people who complete high school (Dianda, 2008). President Obama recently identified improvement in educational outcomes as one of the highest domestic priorities in the United States (U.S. Department of Education, 2014). Of course, many reforms have been tried, including improvements to teacher training, accountability mechanisms, school structures, and curricula, often at high cost and with limited success (e.g., Fullan, 2001; Glazerman et al., 2010). Yet no major reform has

Corresponding Authors:
David Paunesku, Department of Psychology, Stanford University, Jordan Hall, Bldg. 420, 450 Serra Mall, Stanford, CA 94305
Email: paunesku@stanford.edu

Gregory M. Walton, Department of Psychology, Stanford University, Jordan Hall, Bldg. 420, 450 Serra Mall, Stanford, CA 94305
E-mail: gwalton@stanford.edu

prioritized students' psychological experience in school or motivation to succeed, despite the fact that it is ultimately students themselves who must capitalize on learning opportunities. Can psychological science provide scalable techniques to improve students' approach to learning and achievement in high school?

Although social-psychological or academic-mind-set interventions (Farrington et al., 2012) have been influential, none of them have been tested in ways that are potentially scalable. The problem is not so much that past interventions included small samples but that they have generally been tested in only one context at a time and with far greater researcher involvement and control than would be feasible in a large-scale implementation (Farrington et al., 2012; Yeager & Walton, 2011). This includes tailoring materials for each school site, extensive training of participating faculty, and exerting close control over the context and timing of intervention delivery. These studies provide important tests of psychological theory and its application. However, if interventions are not tested in realistic ways with broad samples and minimal researcher input, they remain only exemplary test cases whose practical impact on education outcomes is unclear. As Bryk, Gomez, and Grunow (2011) wrote, "the history of educational innovation is replete with stories that show how innovations work in the hands of a few, but lose effectiveness in the hands of the many" (p. 130).

Are academic-mind-set interventions a practical way to raise achievement in the United States, especially for underperforming students? If so, this would constitute a major contribution of psychological science to social policy and justify increased investment in psychological approaches to educational and social improvement.

To examine whether mind-set interventions could be effective at scale, we transformed existing in-person interventions into brief computer-based modules. Computerized interventions allow materials to be delivered to recipients exactly as designed without extensive researcher involvement or facilitator training; they eliminate geographic constraints, opening access to students at multiple school sites and sites far from research centers; and they drastically reduce logistical burdens, the marginal cost of additional participants, and the costs of data collection and large-scale evaluation (Marks, Cavanagh, & Gega, 2007).

We tested two mind-set interventions—one for *growth mind-set of intelligence*[1] and a second for *sense of purpose*—with more than 1,500 students in 13 high schools. The primary outcomes were grades and satisfactory completion rates in core academic subjects. We focused on effects among poorly performing students, because mind-sets matter most when students encounter challenges in school (Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013; Dweck & Leggett, 1988).

Academic-Mind-Set Interventions

Academic-mind-set interventions target students' core beliefs about school and learning, such as "Can I learn and grow my intelligence?" (growth-mind-set beliefs) and "Why should I learn?" (sense-of-purpose beliefs). In so doing, they can change how students interpret and respond to challenges in school, increase students' resilience, and set in motion positive recursive cycles that increase success over time (Garcia & Cohen, 2012; Yeager & Walton, 2011).

Growth-mind-set interventions convey that intelligence can grow when students work hard on challenging tasks—and thus that struggle is an opportunity for growth, not a sign that a student is incapable of learning. Past studies featuring activities led by researchers or researcher-trained tutors show that this message can raise students' achievement. In a seminal study, J. Aronson and his colleagues (2002) taught a growth mind-set to college students in three 1-hr laboratory sessions and then encouraged students to internalize this message by teaching it to struggling middle school students. This experience raised the college students' semester grade point averages (GPAs). In another study, an eight-session growth-mind-set workshop led by researchers raised the math grades of low-achieving seventh-grade students (Blackwell et al., 2007; see also Good et al., 2003). Because growth-mind-set interventions help students understand challenges in school in a way that promotes learning and resilience, they may be most beneficial for underperforming students (Burnette et al., 2013).

Sense-of-purpose interventions encourage students to reflect on how working hard and learning in school can help them accomplish meaningful goals beyond the self, such as contributing to their community or being examples for other people (Yeager & Bundick, 2009; Yeager, Henderson, D'Mello, et al., 2014). They draw on *relevance interventions* (Hulleman & Harackiewicz, 2009), which help students relate course content to their lives. However, they are framed more broadly, in terms of the value of school in general. Like relevance interventions, sense-of-purpose interventions can sustain students' motivation when schoolwork is boring or frustrating but foundational to learning. In so doing, they can raise achievement, especially among underperforming students (Yeager, Henderson, D'Mello, et al., 2014).

Because mind-set interventions typically target a single keystone belief, they can be brief (e.g., an hour or less) and can be delivered using standardized materials (Cohen et al., 2009; Hulleman & Harackiewicz, 2009; Walton & Cohen, 2011; see Walton, 2014). We focused on growth-mind-set and sense-of-purpose interventions because they seemed most suitable to an initial effort to scale such interventions to heterogeneous settings. They do not require customization to course content (unlike, e.g., Hulleman & Harackiewicz, 2009) or reference students' school context (unlike, e.g., Walton & Cohen, 2011). They use common narratives (e.g., stories from older students) and objective information (e.g., scientific concepts) to change core beliefs about school (J. Aronson et al., 2002). In this way, such interventions can be distributed in a more flexible array of situations than more experiential interventions, which may need to take place within the classroom itself (e.g., Cohen et al., 2009). Furthermore, they benefit underperforming students broadly, unlike interventions that focus on the psychological experience of students from negatively stereotyped groups (e.g., Cohen et al., 2009; Walton & Cohen, 2011).

We took a number of steps to test the interventions under realistic circumstances like those that would be in force when the interventions were scaled-up. We included a heterogeneous sample of schools even though this introduced more variance in outcomes, and we allowed schools to control when and by whom intervention activities would be administered. To retain schools that could not offer extended time for the study, we also dispensed with extensive survey batteries and psychological process measures such as daily diaries (e.g., Walton & Cohen, 2011). By taking these steps and reducing the "super-realization bias" (Cronbach et al., 1980) that can lead to large effect sizes in trials with small, highly controlled samples (Ioannidis, Cappelleri, & Lau, 1998; Slavin & Smith, 2009), we expected to find more modest but more realistic and broadly reliable effects.

When psychological-science researchers examine social problems, the remedies that emerge from their research are often impractical or not tested in ways that can be meaningfully scaled up. This is perhaps one reason why psychological science has played only a limited role in many major policy debates. In the current study, we tested whether academic-mind-set interventions can have a meaningful impact on academic outcomes when delivered to a large sample in a scalable way. If so, our results could stand as a model for research that takes theory into practice.

Method

Participating schools and students

Thirteen high schools, recruited through a series of presentations to educators or brief phone meetings, agreed to participate and provide participating students' academic records. The schools were located in the eastern, western, and southwestern United States. Eight were public schools, four were charter schools, and one was a private school. They varied widely in socioeconomic characteristics: In five schools, almost no students received free or reduced lunch because of low household income; in six, more than half of students did (see Table 1).

To maximize external validity and power, we sought to include as many students as possible in the study. Consequently, we permitted all interested schools to take part provided that they agreed to try to enroll 100 or more students and to provide academic outcomes for participating students (not all schools reached this benchmark). Our analyses focus on the 1,594 students for whom both preintervention and postintervention semester grades were available.

Procedure

Participating schools were asked to select a study coordinator who would recruit teachers to participate and follow-up with teachers if classrooms lagged. The coordinator asked teachers to create accounts on the study Web site (http://www.perts.net) and to schedule two 45-min sessions about 2 weeks apart (mean = 13 days). Both sessions were administered in the school computer lab during the spring semester, between January and May 2012. In an online registration process, teachers agreed to describe the activities to students as a part of an ongoing Stanford University study about why and how students learn. After signing into the study Web site, each student was individually randomly assigned to a control condition or to one of three intervention conditions: growth-mind-set intervention, sense-of-purpose intervention, or the two interventions combined. For all groups, the growth-mind-set intervention (or related control materials) was delivered in Session 1; the sense-of-purpose intervention (or related control materials) was delivered in Session 2. Students from all four conditions thus took part in both sessions.

The growth-mind-set intervention drew directly on past research (J. Aronson et al., 2002; Blackwell et al., 2007; Good et al., 2003) for both content and procedures; however, the material was revised to be effective within a single 45-min online session. Students read an article describing the brain's ability to grow and reorganize itself as a consequence of hard work and good strategies on challenging tasks. The article focused on the implications of neuroscience findings for students' potential to become more intelligent through study and practice. In keeping with our focus on underperforming students, the article stressed the fact that struggle and setbacks in school do not indicate limited potential; rather, they provide opportunities to learn. This message was reinforced through two writing exercises (see E. Aronson, 1999; J. Aronson et al., 2002). In one, students summarized the scientific findings in their own words. In the second, they read about a hypothetical student who was becoming

Table 1. Participating Schools and Their Demographics

School	School type	Number of participants	Total school enrollment	Students on free or reduced-price lunch (%)	Mean SAT score (out of 2400)	Racial composition of school				
						Asian (%)	Black (%)	Hispanic (%)	White (%)	Other (%)
1	Public	361	1,824	8	1795	60	1	9	28	2
2	Public	224	1,129	—	—	8	14	6	54	18
3	Public	172	1,781	68	1376	1	2	90	5	2
4	Public	135	238	85	1193	13	27	53	2	4
5	Public	132	2,059	0	1737	8	1	6	81	4
6	Public	119	2,037	64	1430	2	1	88	8	1
7	Charter	79	1,852	6	1951	23	4	9	58	7
8	Charter	77	416	56	—	9	24	42	15	9
9	Public	76	174	71	1268	4	21	56	6	13
10	Charter	69	297	39	1255	3	64	26	4	3
11	Private	68	2,049	31	1785	11	6	39	41	2
12	Charter	52	709	4	1562	0	1	5	93	1
13	Public	30	192	90	—	—	—	—	—	—

Note: Not all information was available for all schools. Total school enrollment is reported for the 2011–2012 school year.

discouraged and beginning to think of himself as not smart enough to do well in school. Participating students were asked to use what they had read to advise this student. In the control condition, students read and completed similar-seeming materials; however, these materials focused on functional localization in the brain, not neural plasticity. They thus lacked the key psychological message that intelligence is malleable.

The sense-of-purpose intervention was designed to help students articulate how schoolwork could help them accomplish meaningful, beyond-the-self life goals. The materials also drew directly on past research (Yeager, Henderson, D'Mello, et al., 2014). In the intervention, the students were first asked to write briefly about how they wished the world could be a better place. It went on to say that many students work hard in school because they want to grow up to "make a positive impact on the world," to "make their families proud," or to be "a good example for other people." Students were then asked to think about their own goals and to write about how learning and working hard in school could help them achieve these goals. In the control condition, students completed either of two similarly formatted modules that did not differ from each other in their impact, *t*s < 1, and were combined in analyses. One asked students to describe how their lives were different in high school than before high school. The other was very similar to the sense-of-purpose treatment but put forward economic self-interest rather than prosocial contribution as a reason to work hard in school. We included this second control condition to establish that focusing on beyond-the-self goals, not just any personal future goal, is an important component of the intervention, a hypothesis supported by prior work (Yeager, Henderson, D'Mello, et al., 2014; Yeager & Bundick, 2009).

All students who entered the study and for whom pre- and postintervention grades were available were included in the analyses (e.g., students who completed Session 1 but not Session 2 are retained with their original random condition assignment). Thus, we performed an intention-to-treat analysis. Sample demographics are presented in Table 2. Degrees of freedom varied because not all students completed all survey questions.

Psychological measures

Brief psychological measures were administered at the start of Session 1 and at the end of Session 2. First, to confirm that the growth-mind-set intervention changed students' beliefs about the malleability of intelligence, we assessed this belief using two items: "You can learn new things, but you can't really change your basic intelligence" and "You have a certain amount of intelligence and you really can't do much to change it" (α = .84; see Blackwell et al., 2007). Second, we examined students' construal of mundane academic tasks using a meaningfulness-of-schoolwork task (Yeager, Henderson, D'Mello, et al., 2014; see also Steger, Bundick, & Yeager, 2012), which assesses whether students view schoolwork (e.g., "Doing your math homework") at a low, mechanical level (e.g., "Typing numbers into a calculator and writing formulas") or at a high level relevant to learning and growth ("Building your problem-solving skills"; see Michaels, Parkin, & Vallacher, 2013). Eight items formed a reliable composite, α = .72. Although this measure is more closely

Table 2. Demographic Characteristics of the Sample

Characteristic	*n*	%
Gender		
Female	800	50
Male	794	50
Race		
Hispanic	525	33
White	371	23
Asian	277	17
Black	174	11
Other, mixed	247	15
Grade level		
9th	1,307	82
10th	68	4
11th	156	10
12th	63	4

Note: Data on individual students' socioeconomic status (SES) were not collected; however, the percentage of students receiving free or reduced-price lunches, a measure of school-level SES, was known for all public and charter schools (12 of 13 participating schools; see Table 1).

matched to the purpose of schoolwork, it seemed reasonable that the results of the meaningfulness-of-schoolwork task could be influenced by both interventions insofar as both interventions attempted to induce students to perceive the purpose of schoolwork to be learning and growth.

Measures of academic performance

Schools provided participating students' transcripts. Ten schools coded students' performance on a five-letter grading scale (A, B, C, D, F), whereas three assigned "no credit" (NC) in place of Ds and Fs. To numerically transform letter grades for analysis, we always coded A, B, and C as 4, 3, and 2, respectively. Because there was no single a priori basis by which to code D, F, and NC, we used three schemes: D = 1, F = 0, and NC = missing; D = 1, F = 1, and NC = 1 (because they are all unsatisfactory); or F = 0, D = 1, and NC = 1 (because D and NC are immediately below C). The current results are presented using the final coding scheme because it (a) retained all data (unlike the first scheme) and (b) distinguished between F and D (unlike the second scheme); however, all three coding methods provided comparable results. We also created a dichotomous measure of unsatisfactory progress, with grades of D, F, NC, and incomplete (I) marked as unsatisfactory and grades of A, B, C, pass (P), and credit (CR) marked as satisfactory.

We calculated each student's end-of-semester GPA in core academic courses (i.e., math, English, science, and social studies) in the fall (preintervention) and in the spring (postintervention). We focused on core academic courses because these courses are generally most crucial to students' success and because they are the most challenging (mean core GPA = 2.45; mean noncore GPA = 3.15). Thus, they are the most relevant to the interventions.[2]

Results

Baseline associations

After we controlled for school, race, and gender, prestudy GPA was positively associated with baseline values for both growth mind-set, $\beta = 0.06$, 95% confidence interval (CI) = [0.03, 0.09], $t(1561) = 3.47$, $p < .001$, and sense of purpose, $\beta = 0.05$, 95% CI = [0.01, 0.08], $t(1551) = 2.67$, $p = .008$.

Manipulation checks

A linear regression analysis in which we controlled for prestudy beliefs about intelligence showed that the growth-mind-set intervention led to a more malleable view of intelligence, $\beta = 0.17$, 95% CI = [0.05, 0.28], $t(1007) = 2.82$, $p = .005$, but the sense-of-purpose and combined interventions did not, ps > .24.

A linear regression controlling for preintervention meaningfulness of schoolwork showed that the sense-of-purpose group perceived mundane academic tasks as more relevant to learning and growth than did the control group, $\beta = 0.17$, 95% CI = [0.03, 0.32], $t(1000) = 2.37$, $p = .018$; this was also true for the growth-mind-set group, but only marginally, $\beta = 0.11$, 95% CI = [−0.01, 0.23], $t(1000) = 1.77$, $p = .078$. The combined interventions again showed no significant effect, $t < 1$.

Grade point average

To determine whether the intervention influenced post-study GPA and did so to a greater extent for students with a history of underperformance, we tested whether intervention effects would emerge among students who met "high-yield" indicators of dropping out from high school. This threshold was created by the Consortium for Chicago School Research using decades of official records from Chicago public schools (see Allensworth & Easton, 2007; Heppen & Therriault, 2008). In our sample, 519 students (33%) earned a baseline first-semester GPA of 2.0 or less or failed at least one core academic course.

In the semester before the intervention, the intervention and control groups did not differ in GPA, ts < 1. We conducted a linear regression analysis that included risk (0 = not at risk, 1 = at risk), a dummy variable for each intervention condition, and a dummy variable for each Risk × Intervention (growth mind-set, sense of purpose, combined) interaction. The outcome was core GPA for the semester after intervention. We controlled for prestudy GPA, race, gender, and school. The regression revealed

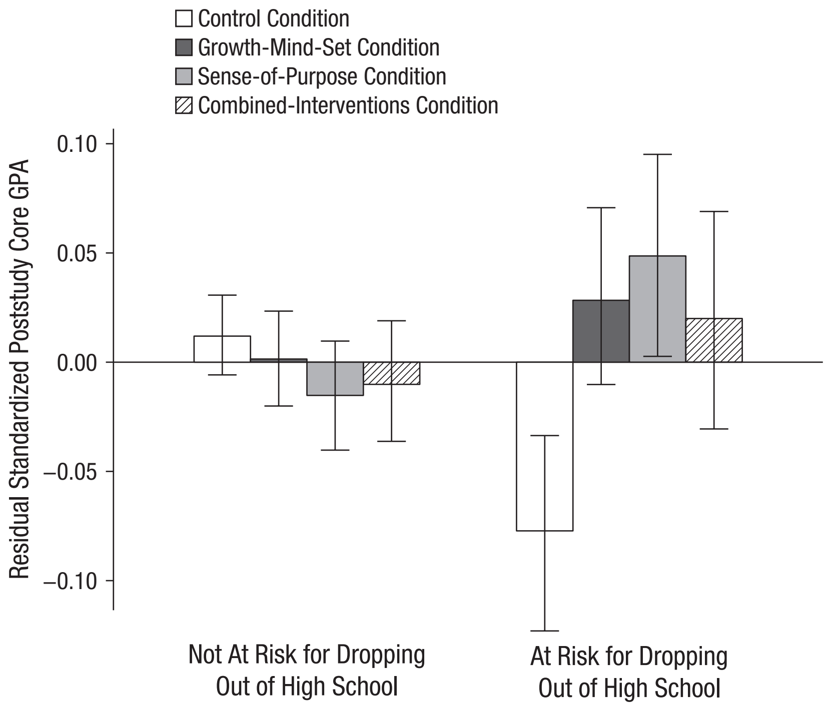

Fig. 1. The effect of the interventions on grade point average (GPA). Residual standardized poststudy core GPA is graphed as a function of risk (n = 519 students at risk of dropping out of high school; n = 1,075 students not at risk of dropping out) and condition. These residuals were calculated controlling for at-risk status, prior GPA, school, race, and gender. Error bars indicate ±1 *SE*.

the predicted Risk × Intervention interaction for each intervention condition: This interaction was significant for the growth-mind-set intervention, b = 0.13, 95% CI = [0.00, 0.26], $t(1568) = 1.97$, $p = .048$, and the sense-of-purpose intervention, b = 0.17, 95% CI = [0.03, 0.32], $t(1568) = 2.31$, $p = .021$, and it was marginally significant for the combined interventions, b = 0.14, 95% CI = [−0.01, 0.28], $t(1568) = 1.81$, $p = .071$ (Fig. 1).

Because our primary research question concerned the efficacy of academic-mind-set interventions in general when delivered via online modules, we then collapsed the intervention conditions into a single intervention dummy code (0 = control, 1 = intervention). We again controlled for prestudy GPA, race, gender, and school. The regression analysis revealed a significant At Risk × Intervention interaction, b = 0.14, 95% CI = [0.03, 0.25], $t(1572) = 2.56$, $p = .011$, such that the intervention effect was significant among at-risk students, b = 0.13, 95% CI = [0.02, 0.25], $t(499) = 2.30$, $p = .022$, but not among other students, $t < 1$.[3] The three intervention conditions produced similar benefits for at-risk students (mean change in GPA—control condition: 0.04; growth-mind-set condition: 0.15, sense-of-purpose condition: 0.18, combined-interventions condition: 0.13),[4] and the effect of intervention among at-risk students was not moderated by race or gender, ps > .21.

It is intriguing that students who received both interventions did not show greater benefits. To our knowledge, only two past studies have tested the effects of combining mind-set interventions; neither found that the combination yielded greater benefits than the individual interventions (Good et al., 2003; Yeager, Walton, Brady, et al., 2014, Experiment 2). Why? In the case of the present study, one possibility is that the two psychological messages were not integrated. Absent this, it may have been difficult for students to fully incorporate two simultaneous and distinct changes to their basic beliefs about schoolwork; that is, students may have received only a partial "dose" of each intervention. This interpretation is consistent with the lack of manipulation-check effects in the combined condition (for a similar pattern, see Yeager, Walton, Brady, et al., 2014, Experiment 2). Future research on combined interventions should integrate the chosen interventions so that they enhance and support each other rather than presenting separate and possibly confusing messages about learning and school.[5]

Satisfactory performance

Satisfactory grades (e.g., A, B, C) denote minimal acceptable proficiency in a subject and are often required for entry into higher-level courses. To assess whether the

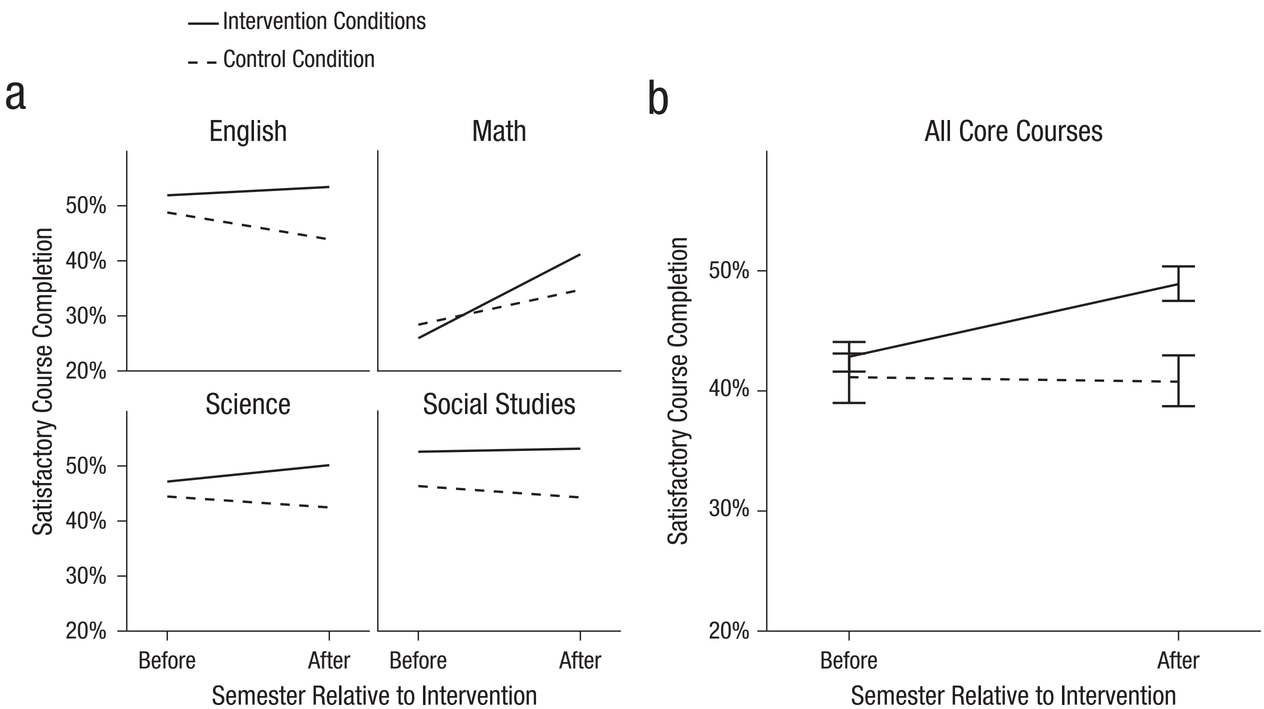

Fig. 2. The effect of the interventions on satisfactory course completion in core courses among students at risk of dropping out of high school. The graphs in (a) show the percentage of students who received satisfactory grades (A, B, C, pass, or credit) in all core courses in the semesters before and after the interventions were conducted. The graph in (b) shows the average percentage of satisfactory course completion across all core courses in the same semesters. The error bars represent ±1 *SE*.

interventions helped at-risk students clear this academic threshold, we used a logistic mixed-effect model to assess the effect of the intervention on students' likelihood of satisfactory performance in each core academic class (Bates, Maechler, & Bolker, 2012). This analysis was restricted to at-risk students, because these students accounted for the vast majority of postintervention course failures. As the outcomes, we specified satisfactory course completion (earning A, B, C, P, or CR vs. D, F, NC, or I) in each core course before and after intervention; as fixed effects, we specified intervention (dummy-coded), time (0 = preintervention, 1 = postintervention), and their interaction; as random intercepts, we specified each student, course, and school.

There was no effect of condition on preintervention satisfactory course completion rates, $t < 1$. However, the regression revealed a significant Time × Intervention interaction, odds ratio (OR) = 1.48, 95% CI = [1.04, 2.10], $Z = 2.18$, $p = .029$. Intervention-group students were significantly more likely to earn satisfactory grades in core academic classes after the intervention (raw mean = 49%) compared with control-group students (raw mean = 41%), OR = 1.58, $Z = 2.68$, $p = .007$. Moreover, whereas there was no difference in satisfactory completion rates before and after the intervention among control-condition students (−0.4%), $t < 1$, students in the intervention group showed a significant increase (+6.0%), $Z = 4.38$, $p < .001$ (see Fig. 2). The 367 at-risk students in the intervention group took a total of 1,358 core courses; the intervention thus led them to earn satisfactory grades in 87 more courses than would be expected on the basis of control-group rates (1,358 × 6.4%).

Discussion

Are academic-mind-set interventions effective on a small scale only with carefully managed administration? Or do they have the potential to scale up and thereby serve as a partial solution for pervasive underachievement in U.S. high schools? The goal of the present research was to answer these questions. Two interventions, each lasting about 45 min and delivered online, raised achievement in a large and diverse group of underperforming students over an academic semester. Among these students, who accounted for the bottom third of students in the sample, the interventions raised GPA in core academic classes and led students to earn satisfactory grades in more core classes. Crucially, these effects were obtained across a sample of heterogeneous schools and in response to interventions that could be scaled to virtually unlimited numbers of students at low marginal cost. Among the 4.93 million students who constitute the lowest-performing third of high school students nationwide, could this translate into a proportional 1.18 million additional successfully completed courses? The results suggest this possibility. Moreover, the methods tested here provide a feasible way to disseminate these interventions and evaluate them on a large scale.

A critical next step is to examine how mind-set interventions interact with diverse contexts (Hanselman, Bruch, Gamoran, & Borman, 2014; Walton, Logel, Peach, Spencer, & Zanna, in press). Our sample was heterogeneous, but it was nonetheless a convenience sample. Mind-set interventions depend on resources and learning opportunities in the academic environment: They encourage students to take advantage of such opportunities and may be ineffective if these opportunities are absent. Evaluating mind-set interventions with a larger and more representative group of adolescents will help identify settings in which students' beliefs serve as barriers to achievement; in such settings, mind-set interventions may be essential, but in other settings, the interventions may have less impact. For instance, further research might reveal settings in which mind-set interventions are redundant with messages already present or in which students lack access to challenging learning opportunities. In conducting this research, it will be critical to ensure that intervention modules retain their psychological essence; mind-set interventions "are not magic . . . they are tools to target important psychological processes in schools" (Yeager & Walton, 2011, p. 293). If a mind-set intervention does not speak to students' psychological experience, it will not be effective. More broadly, this future research will deepen our understanding of the role of psychological processes in the context of other factors that shape student achievement.

It is also important to examine potential long-term effects among high-achieving students, for whom the benefits of mind-set interventions may not emerge until schoolwork becomes challenging, such as when students take advanced coursework or transition to college.

Conclusion

In recent years, psychologists have called for a new emphasis on testing the replicability of psychological research (Pashler & Wagenmakers, 2012) and on examining real-world behavioral outcomes (Schneider, Gruman, & Coutts, 2011). In demonstrating the potential for academic-mind-set interventions to be effective on a wide scale, the present research provides a case study of the health of our field and its relevance to public concerns. The interventions we tested draw directly from an intellectual lineage in psychology, including basic theory (e.g., Dweck & Leggett, 1988), careful laboratory experiments (e.g., Mueller & Dweck, 1998), and small-scale field experiments (e.g., J. Aronson et al., 2002; Blackwell et al., 2007). Our research simultaneously advances this lineage and addresses an important social problem in a scalable way.

Author Contributions

D. Paunesku and G. M. Walton developed the study concept. D. Paunesku, G. M. Walton, C. Romero, D. S. Yeager, and C. S. Dweck contributed to the study design. Data collection was performed by D. Paunesku and C. Romero. D. Paunesku and E. N. Smith performed the data analysis. D. Paunesku and G. M. Walton drafted the manuscript. All authors provided critical revisions and approved the final version of the manuscript for submission.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Supplemental Material

Additional supporting information can be found at http://pss.sagepub.com/content/by/supplemental-data

Notes

1. This has also been called an *incremental theory of intelligence* in past research.
2. When we included all reported grades, the pattern of results was similar to that derived from core GPA, albeit weaker. Even so, the contrast between the three intervention conditions and control condition remained significant ($p < .05$).
3. Nearly identical results for the collapsed intervention conditions were obtained using a mixed model with individual course grade as the outcome, $b = 0.14$, 95% CI = [0.03, 0.25], $p = .011$. Individual intervention effects using a mixed model were also similar to those reported, $.034 < ps < .054$ (see Supplemental Material available online).
4. Changes in psychological measures were not related to changes in achievement, $ts < 1.50$, a pattern in keeping with the

inconsistency with which self-report measures mediate behavioral changes (e.g., J. Aronson et al., 2002; Wilson & Linville, 1982).

5. A second possibility is that the two interventions, even though they differed in substantive ways, shared a common underlying ingredient and were therefore partly redundant. Indeed, each provided a reason to work hard in school for students who lacked such a reason. The lack of manipulation-check effects in the combined condition does not suggest this interpretation; however, other measures of beliefs/motivation could suggest such a common ingredient.

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