# Growth mindset tempers the effects of poverty on academic achievement

**Susana Claro**[a,1], **David Paunesku**[b], **and Carol S. Dweck**[b,1]

[a]Graduate School of Education, Stanford University, Stanford, CA 94305-3001; and [b]Department of Psychology, Stanford University, Stanford, CA 94305

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**Two largely separate bodies of empirical research have shown that academic achievement is influenced by structural factors, such as socioeconomic background, and psychological factors, such as students' beliefs about their abilities. In this research, we use a nationwide sample of high school students from Chile to investigate how these factors interact on a systemic level. Confirming prior research, we find that family income is a strong predictor of achievement. Extending prior research, we find that a growth mindset (the belief that intelligence is not fixed and can be developed) is a comparably strong predictor of achievement and that it exhibits a positive relationship with achievement across all of the socioeconomic strata in the country. Furthermore, we find that students from lower-income families were less likely to hold a growth mindset than their wealthier peers, but those who did hold a growth mindset were appreciably buffered against the deleterious effects of poverty on achievement: students in the lowest 10th percentile of family income who exhibited a growth mindset showed academic performance as high as that of fixed mindset students from the 80th income percentile. These results suggest that students' mindsets may temper or exacerbate the effects of economic disadvantage on a systemic level.**

mindset | academic achievement | income | inequality | education equality

Socioeconomic background is one of the strongest, best established predictors of academic achievement (1, 2). It is well-known that economic disadvantage can depress students' academic achievement through multiple mechanisms, including reduced access to educational resources, higher levels of stress, poorer nutrition, and reduced access to healthcare (3–5). Nonetheless, students with the same economic background clearly vary in their academic outcomes, and researchers have long suggested that students' beliefs, such as locus of control, may temper or exacerbate the effects of economic disadvantage on academic achievement (6–9). However, there has been a lack of clarity as to what these beliefs are or how they interact with structural factors, like economic disadvantage, on a systemic level. The current research identifies a belief—students' mindset about intelligence—that is systematically associated with economic disadvantage and moderates its effects on achievement. Importantly, it is also a belief that is potentially amenable to change (10–14).

Numerous studies have found that students fare better if they believe that their intellectual abilities can be developed—a belief called growth mindset—than if they believe that their intellectual abilities are immutable—a belief called fixed mindset (15). These studies have documented numerous ways in which mindsets influence behaviors that impact academic achievement (16–18). Students with a fixed mindset tend to avoid situations in which they might struggle or fail because these experiences undermine their sense of their intelligence. In contrast, students who have a growth mindset tend to see difficult tasks as a way to increase their abilities (11) and seek out challenging learning experiences that enable them to do so (16, 17). As a consequence, students who have a growth mindset tend to earn better grades than students who hold a fixed mindset (11, 17, 18), especially in the face of difficulty. Additionally, a number of field experiments have now shown that growth mindset plays a causal role in achievement. These field experiments, including two blinded, randomized, controlled studies conducted with over 1,500 participants each, have shown that targeted interventions can help students start to develop a growth mindset and that such interventions can lead to higher achievement for students facing greater adversity (10–14).

However, because previous research was conducted with unrepresentative samples and lacked socioeconomic data, it has been impossible for researchers to address fundamental questions about the relationship between mindset and socioeconomic achievement gaps. Is the relationship between mindset and academic achievement a lawful pattern that can be observed reliably across an entire nation, and is it strong enough to be practically meaningful when measured against canonical structural factors, like family income? Is there evidence that economic disadvantage reinforces the fixed mindset? Finally, is a fixed mindset even more deleterious to economically disadvantaged students because they must overcome greater obstacles to succeed? We systematically investigate these questions for the first time, to our knowledge, using a national dataset containing all 10th graders in Chile.

PSYCHOLOGICAL AND COGNITIVE SCIENCES

## Materials and Methods

This work uses a dataset of all 10th grade public school students in Chile to address these questions on a national scale. The Chilean Government administers standardized tests to measure the mathematics and language skills of all 10th graders in the country every other year. It also surveys each

### Significance

**This study is the first, to our knowledge, to show that a growth mindset (the belief that intelligence is not fixed and can be developed) reliably predicts achievement across a national sample of students, including virtually all of the schools and socioeconomic strata in Chile. It also explores the relationship between income and mindset for the first time, to our knowledge, finding that students from lower-income families were less likely to hold a growth mindset than their wealthier peers but that those who did hold a growth mindset were appreciably buffered against the deleterious effects of poverty on achievement. These results suggest that mindsets may be one mechanism through which economic disadvantage can affect achievement.**

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Data deposition: The original datasets used for this study belong to the Chilean Department of Education. Applications to access these datasets should be done at www.agenciaeducacion.cl/simce/bases-de-datos-nacionales/ for the SIMCE datasets. The JUNAEB dataset can be downloaded directly from their site at junaeb.cl/wp-content/uploads/2013/02/PRIORIDADES-2012-B%C3%81SICA-MEDIA-COMUNA-CON-IVE-SINAE-OFICIAL.xlsx.

[1]To whom correspondence may be addressed. Email: sclaro@stanford.edu or dweck@stanford.edu.

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**Table 1. Unconditional Pearson correlations between key variables and standardized achievement test scores**

| Variable | Language | Mathematics | Average language and mathematics |
|---|---|---|---|
| Student-level variables | | | |
| Mindset | 0.333 | 0.292 | 0.343 |
| Family income | 0.226 | 0.301 | 0.289 |
| Natural log of family income | 0.249 | 0.331 | 0.319 |
| Mother years of education | 0.275 | 0.338 | 0.336 |
| Father years of education | 0.269 | 0.326 | 0.326 |
| School-level variables | | | |
| Average mindset in school | 0.427 | 0.513 | 0.516 |
| Poverty index | −0.412 | −0.520 | −0.512 |
| SES quintile | 0.402 | 0.508 | 0.500 |
| School mathematics 2010 | 0.486 | 0.625 | 0.610 |
| School language 2010 | 0.525 | 0.528 | 0.578 |

All values reported are significant ($P < 0.001$). Details about each variable are in *SI Materials and Methods*. SES, socioeconomic status.

student, each student's family, and each school. The 2012 student survey for the first time, to our knowledge, measured students' mindsets about the malleability of intelligence using a short version of the standard instrument used by Dweck (15). Students who agreed or strongly agreed with statements suggesting that intelligence cannot be changed (i.e., "intelligence is something that cannot be changed very much" and "you can learn new things, but you can't change a person's intelligence") were categorized as having a fixed mindset, those who disagreed or strongly disagreed were categorized as having a growth mindset, and those who were uncertain were categorized as having a mixed mindset. A categorical system was used in graphical presentations for clarity, whereas a continuous standardized score was used in analyses. The details, including the Spanish translation of the items, are provided in *SI Materials and Methods*.

The analyses include all public school students who answered at least one mindset item and completed at least one standardized test ($n$ = 168,203 and $n$ = 168,553 for mathematics and language, respectively). These students represent 75% of all 10th graders from Chile's public schools, and the schools represent 98% of all 2,392 public schools. A detailed description of the population as well as the imputation methods that were used for missing data are available in *SI Materials and Methods*. The descriptive statistics for variables on the whole population and the analytical sample are listed in Table S1.

## Results

First, we sought to determine whether the relationship between mindset and academic achievement constitutes a lawful pattern that can be observed reliably across an entire nation and whether it is strong enough to be practically meaningful when measured against canonical structural factors, like family income. Consistent with prior findings (1, 19), canonical predictors of academic achievement, such as family income and parents' education, were correlated with test scores in our sample (Table 1). Importantly, the relationship between student mindsets and achievement was comparably strong and held across all students in Chile. Student mindset explained 11.8% of variance ($r = 0.343$) in a composite average of mathematics and language scores, and the top student-level socioeconomic predictor explained 11.3% ($r = 0.336$). The difference between these correlations was statistically significant: Fisher's $r$ to $Z = 2.29$; $P = 0.02$ (20). Among school-level socioeconomic variables, the poverty concentration index was the strongest predictor of test scores (explaining 26.2% of variance), whereas the average mindset at the school—or "school mindset"—was again on par with this variable (explaining 26.6% of the variance). This difference was not statistically significant: Fisher's $r$ to $Z = 1.58$; $P = 0.11$.

Second, we sought to determine the robustness and generalizability of this relationship. We found that the relationship between mindset and achievement could be observed across the socioeconomic spectrum and even when controlling for an extensive list of important student- and school-level factors. As Fig. 1 shows, students who subscribed to a growth mindset outperformed their peers at each family income level. Furthermore, mindset remained a highly significant predictor of achievement across a series of hierarchical linear regression models (21) controlling for all available canonical predictors of achievement (1, 19, 22). Table 2 presents the results, showing that the relationship between mindset and test scores still holds in each of these models. To start, column 2 in Table 2 shows this analysis for standardized mathematics and language scores without any covariates. Column 3 in Table 2 controls for student-level characteristics, including gender, ethnic origin, family income, mother's and father's educations, the presence of household assets (e.g., books, computer), and family structure. Column 4 in Table 2 further adds school-level variables, including the socioeconomic level of the school, school enrollment, average class size, type of administration, urbanicity, geographic region, and the school's 2010 average mathematics and language test scores. With all of these important covariates included, the model accounted for almost all of the variability of scores between schools (93–95% depending on the subject) and 36–44% of the total variance; however, the estimate of the mindset effect on achievement remained significant ($B = 0.203$; SE = 0.002; $P < 0.001$ for language and $B = 0.138$; SE = 0.002; $P < 0.001$ for mathematics). The estimated coefficients suggest that, on average, the academic growth associated with a student who changes from having a fixed mindset to a mixed mindset or from a mixed mindset to a growth mindset is 0.2 SDs on language test scores and 0.13 SDs on mathematics test scores.

We also considered the possibility of reverse causation—perhaps doing well in school leads to a growth mindset rather than the other way around. That is, students who do well may hold positive self-perceptions, such as believing themselves to be intelligent, accomplished students. It is plausible that these positive self-perceptions could lead to other positive beliefs, such as the belief that their intellectual ability can grow over time. To test for reverse causation, we ran the previous model and added controls for a variety of beliefs and expectations that could play a role in this reverse causal process. These beliefs included students' self-assessments of their intelligence and their ability in each subject, such as agreement with the statements "I am smart," "I am better than the majority of my classmates on mathematics tests," and "I do well in language arts." We also controlled for student's and parents' expectations of the student's academic attainment and the degree to which the student liked each subject area and thought that it was important. The relationship between mindsets and achievement remained highly significant when controlling for these factors ($B = 0.171$; $P < 0.001$ for language and $B = 0.119$; $P < 0.001$ for mathematics). Thus, our effect is not because of the fact that students who see themselves as doing well simply observe their academic growth and come to the conclusion that intelligence can be developed.

An additional model was created to assess the reliability of the relationship between mindset and achievement across each individual school. To calculate a range of plausible values for the mindset effect per school, the model included a school-level random component for the mindset coefficient as well as all student- and school-level control variables. Through this analysis, we estimate a positive association between mindset and achievement for each of 2,339 schools included in the sample (the 95% plausible value range for the association between mindset and language per school was 0.077–0.261, and the 95% plausible value range for the association between


**Fig. 1.** Average standardized mathematics and language test scores for students with growth and fixed mindsets by family income decile. *A* shows language scores, and *B* shows mathematics scores. Dashed lines represent students with growth mindset, and solid lines represent students with fixed mindset. For clarity, only fixed mindset and growth mindset (not mixed mindset) students are included. However, we note that mixed mindset students consistently fell in between the two other groups.



mindset and mathematics per school was 0.038–0.200). Details are in *SI Materials and Methods*.

Consistent with prior experimental studies, our results show that, for students with the same observable characteristics, those with a growth mindset achieved at higher levels than those with a fixed mindset. Furthermore, these results show for the first time, to our knowledge, that this relationship is comparably strong with that between family income and achievement and that it holds true systemically—across an entire nation's socioeconomic spectrum and across virtually all of its schools.

A final series of models investigated the prevalence of mindsets as a function of income as well as the relationship between income and achievement as a function of mindset. First, we tested the possibility that economic disadvantage and the limited structural opportunities associated with it could themselves reinforce a fixed mindset. A simple correlation revealed that students' mindsets and family income were, indeed, linked ($r = 0.17$; $P < 0.001$). At the extremes, students from the lowest-income families were twice as likely to endorse a fixed mindset as students from the top-income families and schools (Fig. 2).

Second, we tested whether a fixed mindset was even more harmful to the academic achievement of economically disadvantaged students because those students, lacking the resources of higher-income students, would need to overcome greater obstacles to succeed. A negative interaction between family income (standardized) and mindset in predicting test scores ($B = -0.020$; $P < 0.001$ and $B = -0.018$; $P < 0.001$ for language and mathematics, respectively, which is shown in *SI Materials and Methods*, Table S2) suggested that lower income magnifies the deleterious effects of a fixed mindset or, conversely, that a growth mindset may help

**Table 2. Language and mathematics test scores predicted by mindset score (standardized) when controlling for student- and school-level variables**

| Variables | Test score predicted by mindset with no other controls | Test score predicted by mindset and student-level variables | Test score predicted by mindset and both student- and school-level variables |
|---|---|---|---|
| Language score | | | |
| Mindset regression coefficient | 0.214* | 0.206* | 0.203* |
| SE | 0.003 | 0.002 | 0.002 |
| Student controls | | Included | Included |
| School controls | | | Included |
| No. of students | 168,552 | 168,552 | 168,552 |
| No. of schools | 2,339 | 2,339 | 2,339 |
| Mathematics score | | | |
| Mindset regression coefficient | 0.146* | 0.140* | 0.138* |
| SE | 0.002 | 0.002 | 0.002 |
| Student controls | | Included | Included |
| School controls | | | Included |
| No. of students | 168,203 | 168,203 | 168,203 |
| No. of schools | 2,339 | 2,339 | 2,339 |

Each column describes a maximum likelihood hierarchical linear model with students nested in schools. Column 2 presents mindset standardized regression coefficients without any control variables. Column 3 adds student-level controls. Column 4 adds school-level controls. Full list of controls is available in *SI Materials and Methods*, Table S1.

*Regression coefficients are $P < 0.01$.

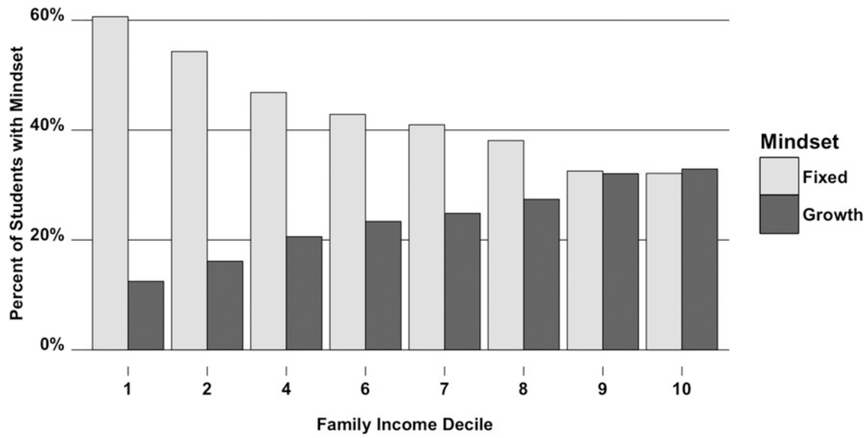


**Fig. 2.** Percentage of students with fixed and growth mindsets as a function of family income. Percentages do not add up to 100 at each income decile because, for clarity, only fixed mindset and growth mindset (not mixed mindset) students are included. However, we note that the percentage of mixed mindset students consistently fell in between the two other groups. Families reported their income by selecting one income range from a list. Some income deciles are missing because on the questionnaires, parents were not offered an income choice corresponding to that decile.

mitigate the negative effects of economic deprivation on academic achievement. This difference is illustrated in Fig. 1, where we observe that, strikingly, students from low-income families (the lowest 10%) who had a growth mindset showed comparable test scores with fixed mindset students whose families earned 13 times more (80th percentile).

## Discussion

The results of this study speak to researchers, educators, and policymakers interested in understanding equality of opportunity. We document for the first time, to our knowledge, on a national scale a robust relationship between students' mindsets about intelligence and their academic performance. Our research shows that, at every socioeconomic level, those who hold more of a growth mindset consistently outperform those who do not—even after holding constant a panoply of socioeconomic and attitudinal factors. The relationship between mindset and achievement holds true across all of Chile's schools and across all levels of family income. In other words, for any two students with equal characteristics, the one endorsing a growth mindset is more likely to enjoy higher academic achievement, suggesting that the benefit of having a growth mindset holds widely. Furthermore, these robust, nation-level correlations are complemented by multiple prior randomized field experiments showing that a growth mindset has a causal impact on achievement (10–14).

These findings also document for the first time, to our knowledge, a relationship between mindsets and economic disadvantage. The lowest-income Chilean students were twice as likely as the highest-income students to report a fixed mindset, and their mindset was an even stronger predictor of success for these low-income students. Although existing data cannot explain why low-income students were more likely to endorse a fixed mindset, this finding does suggest that economic disadvantage may lead to poorer academic outcomes, in part by leading low-income students to believe that they cannot grow their intellectual abilities. The observation that mindset is a more important predictor of success for low-income students than for their high-income peers is novel, although it is consistent with prior research, which has found that a fixed mindset is more debilitating (and a growth mindset is more protective) when individuals must overcome significant barriers to succeed (13, 14).

To be clear, we are not suggesting that structural factors, like income inequality or disparities in school quality, are less important than psychological factors. Nor are we saying that teaching students a growth mindset is a substitute for systemic efforts to alleviate poverty and economic inequality. Such claims would stand at odds with decades of research and our own data. Rather, we are suggesting that structural inequalities can give rise to psychological inequalities and that those psychological inequalities can reinforce the impact of structural inequalities on achievement and future opportunity. As such, research on psychological factors can help illuminate one set of processes through which economic disadvantage leads to academic underachievement and reveal ways to more effectively support students who face additional challenges because of their socioeconomic circumstances.

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