Abstract Title Page.

Title: Mindset Gap among SES Groups: The Case of Chile with Census Data

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Problem / Background / Context:

Students' academic motivation and their achievement is affected by the mindset that students hold about their own intelligence (Dweck, 1999, Rattan et al, 2012, Paunesku, 2013). Students who believe that intelligence can be grown through effort (a *growth mindset*) have shown to perform better than those who believe intelligence is stable (a *fixed mindset*). They are more likely to understand that effort is important for academic success; they are more likely to seek out challenging academic tasks that help them learn; and they are more likely to seek out, pay attention to, and learn from critical feedback (Blackwell et al 2007; Dweck 1999; Dweck and Leggett, 1988; Mangels et al., 2006; Mueller and Dweck, 1998). In short, students who have a growth mindset see challenges as a way to grow their abilities while those with a fixed mindset view challenges as a sign that they lack innate ability. Furthermore, experimental evidence shows that the relationship between growth mindset and academic performance is causal: Students who are taught to adopt a growth mindset earn better grades compared to students randomly assigned to a control condition (Aronson et al., 2002; Blackwell et al., 2007; Good et al., 2003; Paunesku, 2013).

How do students acquire the mindsets they hold while they are at school? There is some evidence that the type of feedback that a student receives can convey one of the two mindsets (Mueller and Dweck, 1998, Rattan et al 2012), suggesting that this mindset could be transferred at school as well as through parents' feedback. There is also evidence that this mindset can be taught, as shown by the experimental evidence mentioned above (Aronson et al., 2002; Blackwell et al., 2007; Good et al., 2003; Paunesku, 2013).

While there is extensive research on how growth mindset affects motivation and achievement, we don't have a diagnosis of how mindset is distributed among the population and whether it correlates with achievement at a national scale. The biggest experimental study included 1,650 high-school students across 13 schools in the US (Paunesku, 2013). We don't know whether what we have learned about growth mindset applies to each subgroup and at a national scale. We would benefit from knowing who are the students with lower mindsets who would benefit from interventions that address this issue (like those implemented by Aronson et al. (2002), Blackwell et al. (2007), Good et al. (2003), and Paunesku (2013)). The current study presents the first time that mindset is studied at a national level thanks to novel census data from Chile. Chilean 10th graders of the whole country were surveyed to measure their mindset at the same time that they completed the national standardized test to measure achievement (SIMCE).

Purpose / Objective / Research Question / Focus of Research:

The current study presents a unique nationally-representative dataset to study the relationship of Mindset and Achievement among different populations. With census data of Chilean 10th graders and their schools, we try to answer the following questions:
o   Controlling by available predictors of achievement, does mindset predict achievement?

- o Does Mindset predict achievement more in some groups than others?
- o What is the distribution of mindset among the different groups of 10th graders in Chile? Are there differences in mindset levels of 10th graders by SES, gender, type of school and rural areas?

Given that research has shown that mindset affects achievement, answers to these questions are needed to be able to address achievement disparities in Chile. In particular, the existence of differences of mindset between SES groups could be one of the channels through which the achievement gap is being perpetuated. It is not possible to achieve equality of opportunities if we don't work in achieving equality of growth mindset across sectors to ensure that students will be able to take the opportunities when they get them.

Improvement Initiative:

This study is unique in several ways:
- This is the first time that mindset is measured at a national level. It shows surprising evidence that students with high levels of growth mindset from low-income quintiles achieve as high as students from the high-income quintile with low levels of mindset.
- This dataset presents the opportunity to learn about how mindset distributes among students from different SES sectors and school types.
- This is the first study to show the unequal levels of mindset between low and high SES students.
- Finally, this is the first time that growth mindset is studied in Latin-America exploring whether relationships between achievement and mindset are consistent with American research

Setting:

Chile, national level

Population / Participants / Subjects:

Population of study is the complete cohort of students in Chile who were in 10th grade in 2012.

Research Design:

SIMCE is a standardized assessment that is implemented every other year to all 10th graders in Chile. In addition to the test, students, parents and teachers complete a questionnaire.
I included an instrument to measure mindset in the 2012 students' questionnaire, based on Dweck (1999) instrument. The current study will describe the data collected through this questionnaire and the corresponding standardized assessments, to answer the questions listed above.

Data Collection and Analysis:

SIMCE is a standardized assessment that is implemented every other year to all 10th graders in Chile. In addition, students complete a questionnaire before starting the test. Parents and teachers

complete questionnaires as well. The 2-item instrument[1] to measure students' mindsets was included in the students' questionnaire. Students' SES information and other demographics of students are reported by parents.

The study draws from 5 different datasets: students' SIMCE scores from 2012, the questionnaires answered by students, teachers and, parents, and school demographics datasets that include the percentage of students with free lunch in the whole school.

To analyze this data we ran simple OLS regressions of mindset on student achievement, in first place, and then subsequently we added controls that usually predict achievement (family income, parents education, gender, school average students' family income, rural school, size, % of free lunch students, among others). We also ran a Schools Fixed Effects model, including separate analysis for each school SES group, and other subgroups.

We also labeled students following their mindset scores, following practices from previous literature (Paunesku, 2013). We divided into three categories: fix mindset (score from 1 to 3), neutral (between 3.1 and 4.9), and growth mindset (5 and above). Then we observed the percentage of these types of mindsets among population subgroups. We run similar analysis for predicting mindset.

Also we provide more information for discarding alternative hypothesis. While this is only a descriptive study and therefore it is not possible to discard confounding elements, we intent to approximate an answer by observing the correlation of questions such as "I am good at math" and mindset, not finding any.

Future analysis will include running a 3-level model—students in teachers in schools, as well as disentangle further why there is a mindset gap across SES levels.

Findings / Outcomes:

Most Chilean students have a fixed mindset (51%). Only 23% have a growth mindset. Those who have a growth mindset perform significantly better on SIMCE language and math tests[2]

- Students with a growth mindset were 4.9x more likely to score in the top achievement quintile (34%) than the bottom quintile (7%).
- Students with a fixed mindset were 2.3x more likely to score in the bottom achievement quintile (28%) than the top quintile (12%).
- 76% of students in the bottom achievement quintile had a fixed mindset, while only 8% had a growth mindset (the remaining 16% had an "intermediate" mindset).

o Controlling by available predictors of achievement, does mindset predict achievement?

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[1] The items were adapted from the Dweck, 1999 instruments.

[2] Math and language scores were standardized and then averaged.

The relationship between student mindset and achievement was equally strong when controlling for school and for socioeconomic status (see Appendix for regression estimates, Table 1). Furthermore, students' mindsets predicted achievement (r=.34) almost as well as their family income (r=.41). Furthermore, they did so at all levels of family income (see Figure 1).

(please insert figure 1 here)

o Does Mindset predict achievement more in some groups than others?

Yes, Mindset is more predictive of achievement at low-socioeconomic groups. Students with high levels of growth mindset from the lowest-income quintile achieve as high as students from the high-income quintile with low mindset. The relationship between mindset and achievement have no meaningful differences between girls and boys, rural and urban, or charter schools and other schools.

o Are there differences in mindset levels of 10th graders by SES, gender, type of school and rural areas?

Mindset is unequally distributed among SES groups. A big mindset gap appears between schools with low and high percentage of free lunch students. Schools that attend students from low socioeconomic backgrounds have more than half a standard deviation lower student mindset average than schools from middle and high socioeconomic groups. (see Figure 2)

(please insert figure 2 here)

Conclusions:

The results of the 2012 SIMCE show that Chilean students who have a growth mindset have, at the same time, higher levels of academic performance, even after controlling for SES elements such as family income, parents education, ethnicity, school SES composition, and other variables that predict achievement. While this is not a causal results, prior research has already established that students' mindsets can be changed through targeted programs, with positive effects on achievement. Only 23% of Chilean students currently have a growth mindset, but those who do are 5x as likely to score in the top fifth on the SIMCE, even if they come from low-socioeconomic families. Mindset more strongly predicts test scores than income.

We observed that there is a high inequality of mindset across SES levels. Poor students are more likely to have a fixed mindset. This situation may help explain one channel through which the achievement gap among the SES groups is perpetuated.

These results have policy relevance. Previous studies have shown that it is possible to change mindsets through very simple and inexpensive interventions (Paunesku, 2013). Schools can play an important role in increasing the mindset of low-ses students to achieve an equal distribution of mindset. If we do not work in addressing the low levels of mindset surfaced among the most disadvantaged students, it is unlikely that we will be able to achieve equal opportunities for all. As shown in previous research, students with fixed mindsets will not be able to take advantage of opportunities unless they are equipped with the right mindset.

Appendix A. References
References are to be in APA version 6 format.

Aronson, J., Fried, C. B., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of Experimental Social Psychology*, 38(2), 113–125.

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development*, 78(1), 246–263.

Dweck, C. S. (1986). Motivational processes affecting learning. American Psychologist, 41(10), 1040-1048.

Dweck, C. S. (1999). Self-theories: Their role in motivation, personality, and development. Philadelphia, PA: Taylor & Francis.

Dweck, C. S. (2006). Mindset. New York: Random House.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review*, 95(2), 256–273.

Mangels, J. A., Butterfield, B., Lamb, J., Good, C., & Dweck, C. S. (2006). Why do beliefs about intelligence influence learning success? A social cognitive neuroscience model. *Social Cognitive and A⏎ective Neuroscience*, 1, 75-86.

Mueller, C. M., & Dweck, C. S. (1998). Praise for intelligence can undermine children's motivation and performance. *Journal of Personality and Social Psychology*, 75, 33–52.

Paunesku, D. (2013) Scaled-up social psychology: Interening wisely and broadly in education. Dissertation, Unpublished Manuscript, Stanford University

Paunesku, D., Yeager, D., Romero, C., & Walton, G. (2012). A brief growth mindset intervention improves academic outcomes of community college students en-rolled in developmental mathematics courses. Unpublished Manuscript, Stanford University.

Appendix B. Tables and Figures
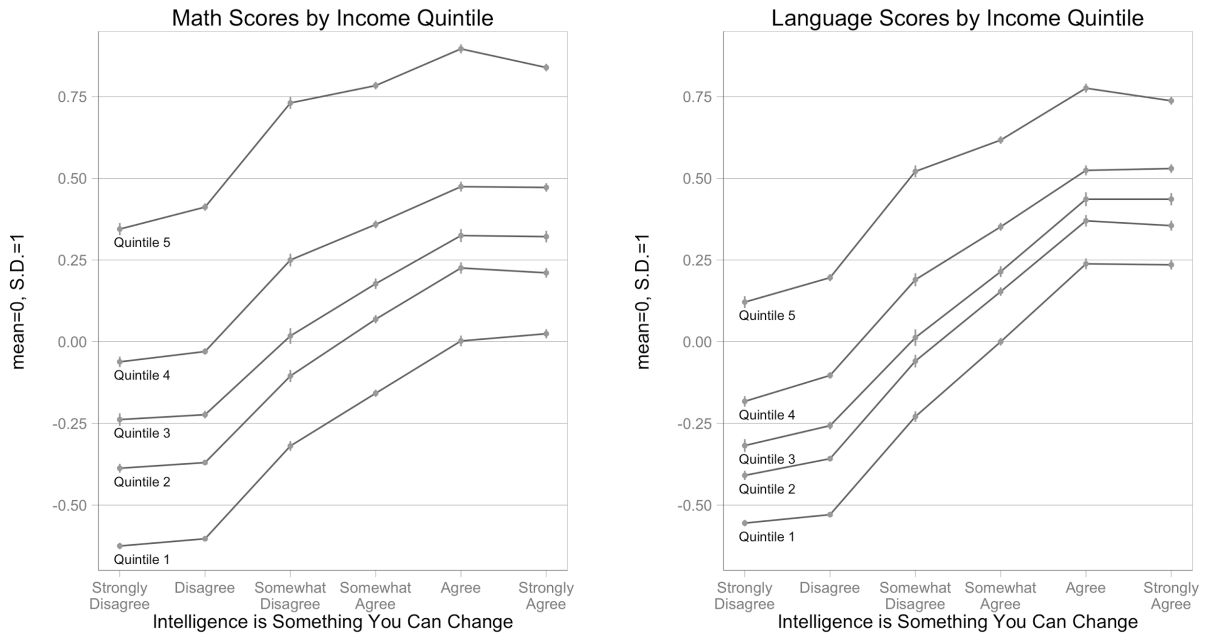
Figure 1: Test scores in math (left) and language (right) per mindset level and income quintile. Each line represents a different family income quintile. The graphs show that, for each income quintile, the higher the mindset the higher the test scores. In the case of language, a child in the lowest income quintile who has a high mindset, is achieving better scores than the richest children who have a low mindset.
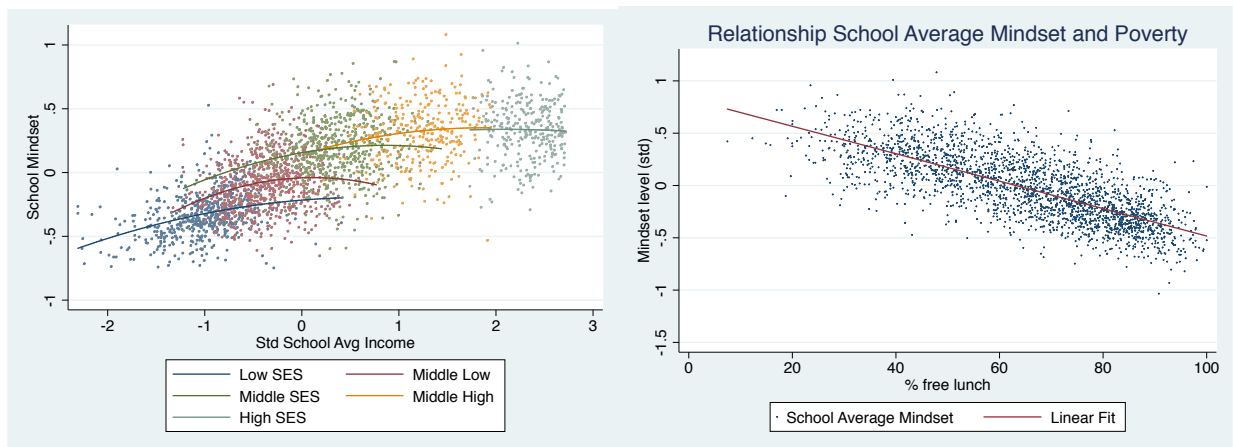
Figure 2: Left: Schools' Average Student Mindset by Schools' Average Students' Family Income (all variables standardized), separated by school SES group (in different colors). Right: School Average Mindset by School Free and Reduced Lunch Percent of Studnets. These graphs shows that schools at lower income levels have lower mindset. This mindset gap may be another source of inequaity among students from different socioeconomic groups that is worth studying deeper.

Table 1: Student Math Score predicted by Student Mindset and other covariates

Mindset or "Theory of Intelligence" is presented as "TOI"

Student Math Score (std)	(1) OLS	(2) OLS	(5) School F.E. Low SES	(6) School F.E. Medium Low	(7) School F.E. Medium	(8) School F.E. Medium High	(9) School F.E. High SES	(10) School F.E. Low SES	(11) School F.E. Medium Low	(12) School F.E. Medium	(13) School F.E. Medium High	(14) School F.E. High SES
Student TOI (std)	0.288***	0.131***	0.178***	0.164***	0.122***	0.081***	0.045***	0.159***	0.142***	0.119***	0.082***	0.052*
	(0.002)	(0.003)	(0.005)	(0.004)	(0.004)	(0.006)	(0.006)	(0.005)	(0.004)	(0.005)	(0.007)	(0.029)
Parent with Highschool		0.071***						0.066***	0.081***	0.076***	0.119***	1.806**
		(0.005)						(0.009)	(0.008)	(0.015)	(0.038)	(0.739)
Parent with College		0.039***						0.023	0.020**	0.045***	0.069***	0.074
		(0.006)						(0.023)	(0.010)	(0.009)	(0.014)	(0.073)
Native Parent		0.004						-0.014	0.018*	0.026*	0.025	0.061
		(0.006)						(0.013)	(0.011)	(0.016)	(0.023)	(0.104)
Stud Ln Income (std)		0.029***						0.051***	0.029***	0.012**	0.026***	0.137**
		(0.003)						(0.006)	(0.006)	(0.006)	(0.009)	(0.058)
Is Female		-0.171***						-0.178***	-0.208***	-0.208***	-0.178***	-0.153***
		(0.005)						(0.010)	(0.009)	(0.010)	(0.014)	(0.036)
School Vulnerability		0.347***										
		(0.046)										
School Size (std)		0.007*										
		(0.004)										
School Avg Math (std)		0.614***										
		(0.009)										
Is Rural		0.021**										
		(0.009)										
Is Private School		-0.067***										
		(0.015)										
Is Charter School		0.006										
		(0.006)										
School Math Score (std		0.027***										
		(0.007)										
Class TOI (std)		0.156***						0.427***	0.522***	0.250***	0.028	0.026
		(0.020)						(0.063)	(0.054)	(0.047)	(0.059)	(0.254)
Class Income (std)		-0.023**						0.114***	0.100**	0.095**	0.117*	-0.208
		(0.010)						(0.042)	(0.045)	(0.046)	(0.067)	(0.177)
Class % parent with col		0.102***						0.472**	0.524***	0.168	0.035	1.311**
		(0.032)						(0.210)	(0.125)	(0.151)	(0.151)	(0.422)
Constant	0.023***	-0.172***	-0.595***	-0.238***	0.362***	0.756***	1.175***	-0.236***	-0.134***	0.274***	0.559***	-1.550**
	(0.002)	(0.041)	(0.001)	(0.000)	(0.001)	(0.002)	(0.002)	(0.049)	(0.028)	(0.043)	(0.103)	(0.605)
Observations	184,152	113,717	40,331	60,014	41,844	17,694	14,887	27,426	42,265	30,744	12,899	383
R-squared	0.083	0.469	0.046	0.045	0.029	0.014	0.005	0.084	0.097	0.055	0.036	0.127
Number of school			571	690	586	307	299	579	640	548	275	12

Standard errors in paren

*** p<0.01, ** p<0.05, *

Table 2: Predictors of Individual Student Mindset:

	(1) OLS	(2) OLS w controls	(3) School F.E. Low SES	(4) School F.E. Medium Low	(5) School F.E. Medium	(6) School F.E. Medium High	(7) School F.E. High SES
Student TOI Score (std)							
Parent with Highschool	0.203***	0.085***	0.107***	0.073***	0.068***	-0.065	0.011
	(0.007)	(0.007)	(0.011)	(0.011)	(0.021)	(0.051)	(0.186)
Parent with College	0.130***	0.044***	0.090***	0.081***	0.033**	0.008	0.040
	(0.007)	(0.009)	(0.027)	(0.015)	(0.013)	(0.021)	(0.040)
Native Parent	-0.036***	-0.013*	-0.043***	-0.020	0.005	0.026	0.092
	(0.007)	(0.007)	(0.013)	(0.014)	(0.019)	(0.034)	(0.069)
Std Ln Income	0.113***	0.038***	0.055***	0.035***	0.027***	0.043***	-0.008
	(0.004)	(0.005)	(0.008)	(0.007)	(0.010)	(0.013)	(0.021)
Is Female	0.076***	0.028***	-0.016	-0.003	0.101***	0.109***	0.097***
	(0.005)	(0.005)	(0.010)	(0.010)	(0.013)	(0.020)	(0.020)
Class TOI (std)		0.988***	0.980***	0.986***	0.979***	0.978***	0.962***
		(0.008)	(0.017)	(0.012)	(0.016)	(0.027)	(0.025)
Class Income (std)		-0.056***	-0.083***	-0.018	-0.024	-0.009	0.008
		(0.008)	(0.021)	(0.021)	(0.028)	(0.038)	(0.069)
Class % parent with college		-0.033**	-0.105	-0.045	0.010	0.056	0.026
		(0.016)	(0.070)	(0.042)	(0.048)	(0.068)	(0.117)
School TOI (std)		-0.020*					
		(0.011)					
School Vulnerability		0.000					
		(0.000)					
School Size		0.000*					
		(0.000)					
School Math Score		0.000					
		(0.000)					
Is Rural		0.006					
		(0.008)					
Is Private School		-0.010					
		(0.008)					
Is Charter School		0.003					
		(0.003)					
School Math Score 2010		-0.000					
		(0.000)					
Constant	-0.092***	-0.116***	-0.050***	-0.047***	-0.125***	-0.058	-0.101
	(0.006)	(0.030)	(0.018)	-0.014	(0.024)	(0.054)	(0.208)
School F.E.			Y	Y	Y	Y	Y
Observations	131,638	115,231	29,343	44,327	32,556	13,993	11,401
R-squared	0.047	0.120	0.043	0.041	0.027	0.023	0.032
Number of school			629	707	596	321	335

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TOI = mindset

Table 3: Predictors of School Average Mindset
- vulnerability and income highly predicts Mindset. (Vulnerability is the % of students with "free and reduced lunch")
- parents education also predicts Mindset – up to a certain SES group
- Schools from Medium High and High SES groups have predicted Mindset.
- High SES group does not include % of vulnerability because information is available for 12 schools only. Also, there is no charter or rural school

School TOI (std)	(1) OLS	(2) OLS	(3) Group1 Low SES	(4) Group2 Medium Low	(5) Group3 Medium	(6) Group4 Medium High	(7) Group5 High SES
% vulnerable students		-0.353***	-0.303**	-0.396***	-0.469***	0.057	
		(0.067)	(0.149)	(0.122)	(0.127)	(0.191)	
school size (std)		-0.009	-0.019	-0.016*	0.000	0.008	0.019
		(0.006)	(0.012)	(0.009)	(0.012)	(0.024)	(0.041)
is rural		-0.055***	-0.055**	-0.097***	0.212	-0.009	
		(0.019)	(0.022)	(0.032)	(0.172)	(0.026)	
is private school		0.352***					
		(0.025)					
is charter school		0.013	0.008	0.009	0.072*	-0.018	
		(0.011)	(0.016)	(0.015)	(0.039)	(0.123)	
Math Score 2010 (std)	0.096***	0.069***	0.048***	0.081***	0.074***	0.040*	0.443
	(0.007)	(0.007)	(0.015)	(0.011)	(0.015)	(0.023)	(0.171)
Average Income 10th grade (std)	0.142***	0.015	0.062**	-0.020	0.023	0.060	-0.121
	(0.007)	(0.016)	(0.026)	(0.030)	(0.033)	(0.056)	(2.288)
% Parents w Highschool		0.415***	0.171**	0.502***	0.271	0.469	0.801
		(0.039)	(0.070)	(0.084)	(0.208)	(0.652)	
% Parents w College		0.173***	0.465***	0.149	0.199	0.321*	0.386
		(0.053)	(0.158)	(0.132)	(0.122)	(0.171)	(1.508)
Constant	-0.016***	-0.482***	-0.067	-0.166	0.065	-0.478	-0.586
	(0.005)	(0.065)	(0.125)	(0.103)	(0.190)	(0.628)	
Observations	2,390	2,056	580	641	548	275	315
R-squared	0.534	0.625	0.192	0.260	0.161	0.078	0.051

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
TOI = mindset

Figure 5: School mindset by Average Income:
What predicts School Mindset:
- Income predicts school mindset, but not so much on the 40% higher income schools.
- Though this may mean that the relationship mindset-scores may be capturing income-scores, it is interesting to note that one way higher income schools differentiate from their lower income peers is by conveying a more growth mindset. Mindset could become one of the candidate reasons for why higher income schools have better results.