Inequality's Association with Poor Educational Outcomes in U.S. States Relates to Interest in
Academic Shortcuts

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Abstract

Regional income inequality is associated with poor academic outcomes. Using U.S. data (2005 - 2016), we explored whether inequality has psychological consequences that may harm student outcomes. Theoretically, income inequality causes excessive focus on immediate concerns, therefore we examined whether inequality is associated with increased interest in academic shortcuts, and whether interest in shortcuts explains the academic outcomes of 4th graders, 8th graders, and adults. We used state-level Google search frequencies to measure interest in academic shortcuts (e.g., “cliff notes”). Inequality was associated with 8th grade standardized test performance and adult high school degrees, but not 4th grade standardized test performance. Interest in academic shortcuts mediated the effect of inequality on 8th grade performance and high school degrees (with some caveats). Our analyses are consistent with theorized psychological consequences of inequality suggesting that it biases students’ focus on the present in ways that undermine their educational achievement and attainment.

Keywords: Income inequality, academic achievement, Google Correlate, educational attainment

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Inequality's Association with Poor Educational Outcomes in U.S. States Relates to Interest in Academic Shortcuts

Education is assumed to be a leveling force capable of reducing inequality. But studies in economics, sociology, and psychology suggest that inequality can undermine education. Nations with more income inequality have lower average test scores (Wilkinson & Pickett, 2007), and a country's income inequality explains part of the variation in its students' test performance (Chiu, 2007). Within the United States, in more income-unequal states, there are higher high school dropout rates, adults earn fewer advanced degrees, and students score relatively lower on math and reading standardized tests (Kearney & Levine, 2014; Wilkinson & Pickett, 2010).

The effects of income inequality are separate from those of poverty. Whereas poverty refers to a region's average level of income, inequality is comparative and refers to the distribution of wealth in a region. The effects of inequality, after accounting for income, may stem from the social comparisons it triggers. Regional inequality may increase the salience of social class because it is associated with more signaling of status through clothing, speech, and expressions (for a review, see Kraus, Park, & Tan, 2017). Moreover, because people tend to focus on upward comparisons (Festinger, 1954), inequality can increase perceptions of need (Payne, Brown-Iannuzzi, & Hannay, 2017), and as a result, polarize peoples' judgments of their social class as they look to those around them to determine their own class (Andersen & Curtis, 2012). In conditions of inequality, the salient wealth of the ultra-rich makes everyone feel they need more.

What mechanisms might link inequality to school achievement? One possibility is that by making people feel they need more, inequality biases people towards short-term goal pursuits. From a functional perspective, when people have pressing needs, it is adaptive to take advantage of immediately available opportunities regardless of potential future costs. This logic does not necessarily guide conscious decision-making, but instead seems to operate

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via a generalized focus on short-term goals (Shah, Mullainathan, & Shafir, 2012; Shah, Shafir, & Mullainathan, 2015). This present-bias has been captured in the laboratory: When told they had relatively less discretionary income than others, people consistently chose smaller, more immediate rewards over larger but delayed rewards (Callan, Sheard, & Olson, 2011). Consistent with this account, inequality has been associated with other outcomes that reflect myopic decision-making such as higher rates of crime (Fajnzylber, Lederman, & Loayza, 2002; Hsieh & Pugh, 1993) and worse health (Kondo et al., 2009; Subramanian, Kawachi, & Kennedy, 2001).

Decision-making that optimizes the short term undermines school achievement. Educational success requires daily work over long periods, which is unpleasant in the short term but results in future benefits. Students who are more future-oriented and who make choices that favor long-term goals do better in school. Better academic performance is associated with less delayed discounting (Kirby, Winston, & Santiesteban, 2005), a more future-oriented perspective (Shell & Husman, 2001), feelings of connection to one's future self (Adelman et al., 2017), lower impulsivity, higher self-control, and a tendency to delay gratification (Duckworth & Seligman, 2005). Prioritization of long-term goals not only affects the grades students receive, but also the strategies they use to complete school work and how much effort they devote to academic tasks (Joireman, 1999; Malka & Covington, 2005; Peters, Joireman, & Ridgway, 2005; Simons, Dewitte, & Lens, 2003; Simons, Vansteenkiste, Lens, & Lacante, 2004). The easiest and fastest strategies for completing work, such as guessing, looking up answers, or submitting others' work, are *academic shortcuts* that optimize short-term goals and result in low performance on tests of knowledge (e.g., King & McInerney, 2014). The hardest and most delayed strategies for completing work, such as self-testing and working until gaining full mastery, optimize long-term learning and result in higher performance on tests of knowledge (e.g., Hartwig & Dunlosky, 2012).

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In this paper, we test the hypothesis that the link between inequality and educational achievement may be explained, in part, by interest in taking academic shortcuts. We measured interest in academic shortcuts using data on Google searches for terms related to low-effort academic strategies, a behavioral indicator that students are focused on maximizing immediate rewards. We took a developmental approach because, as people age, they have more autonomy over the tools they use to achieve their goals and how they spend their time. In addition, though even very young children perceive socioeconomic status (Baldus & Tribe, 2008; Ramsey, 1991; Tudor, 1971), it becomes more meaningful social information later in development (Sigelman, 2012, 2013). Thus, older students and adults should be affected more than children in elementary school by the hypothesized effects of inequality. Furthermore, decisions that favor the short-term over the long-term have consequences that manifest and accumulate in the long-term. Thus, a pattern of taking academic shortcuts in middle school can contribute to educational outcomes years or decades later. We used a cross-sectional sample to test developmental differences, examining the academic outcomes of students in 4th grade (standardized test performance), 8th grade (standardized test performance), and adults (high school graduation rate).

Though prior evidence shows that, relative to more equal states, income-unequal states generate more Google searches for words related to academic shortcuts and cheating (Neville, 2012), past research has not examined the link between such searches and educational outcomes. Here, we examined whether searching for academic shortcuts can partly account for the relationship between state-level income inequality and academic performance, and whether these effects differ across developmental groups.

Method

This study used public data collected and disseminated by the U.S. Government to operationalize states' income inequality, income, and educational outcomes. State-level Google search frequency were publicly available at *Google Correlate*

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(www.google.com/trends/correlate/). The unit of analysis for all data sources was U.S. States and the sample was all states, excluding data from territories (e.g., Puerto Rico). Our N was fixed at 50 (the number of states). A sample size of 50 is sensitive enough to detect zero-order population correlations greater than or equal to .37 at .80 power. Google search data are not available retrospectively and were obtained in 2016. To align the state data with the Google search data, income inequality and educational outcomes prior to 2016 were used. For our state-level inequality, income, and educational outcome variables, all available data from roughly a ten-year period before 2016 were averaged to obtain the most accurate estimates.

Measures

State-level income inequality was measured in two ways. First, it was measured using the Gini coefficient, a number that describes the distribution of total resources in a population (here, the distribution of household income among the people that live in a U.S. State). A Gini coefficient of zero indicates that everyone has exactly the same amount of wealth and a Gini coefficient of one indicates that one person has all the wealth. We used Gini coefficients that were calculated and published by the U.S. Census Bureau, averaged across nine years ($\alpha = .993$; U.S. Census Bureau, Current Population Survey 1-year estimates, 2006-2015).

Second, we measured inequality using mean-centered earnings ratio: the ratio of the household incomes of people in the 50th percentile to those in the 10th, and the earnings of people in the 90th percentile to those in the 50th. Unlike the Gini coefficient, our measures of earnings ratios capture inequality that is driven by extreme relative poverty and inequality that is driven by extreme relative wealth, respectively. The 50:10 ratio captures how well middle-income earners are doing relative to low income earners, and the 90:50 ratio captures how well high-income earners are doing relative to middle income earners. When these ratios are together in a model, estimates can indicate the unique influence of inequality due to the presence of extreme wealth (90:50) independent of inequality due to extreme poverty (50:10). These ratios are useful for testing the hypothesis that the psychological effects of inequality

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are driven by the presence of relative wealth, rather than the presence of relative poverty. The income ratios were constructed by Beth C. Truesdale and J.L. Herrera based on household income data from the 2010 to 2014 waves of the American Community Survey (5-year estimates) conducted by the U.S. Census Bureau.

State-level income, which we used in a robustness check, was measured by per capita household income rather than median income following Neville (2012). We used income data calculated and published by the U.S. Census Bureau, averaged across ten years ($\alpha = .997$; U.S. Census Bureau, Current Population Survey, 1-year estimates, 2005-2015).

State-level interest in academic shortcuts was approximated using Google Correlate, a publicly available online tool that provides information about relative search term frequency. We used this measure as a proxy for a broader latent construct, greater valuation of short-term outcomes, that should manifest – more or less precisely – in other measures of valuation of short-term versus long-term academic outcomes, such as the actual use of academic shortcuts. We chose Google search data because provides a precise measurement of a behavior that captures people's desires and motivations, psychological information that is hard to otherwise access at the state-level. In addition, there was precedent for using Google search data to understand psychological effects of inequality in U.S. States (Neville, 2012; Walasek & Brown, 2015).

The research team generated 40 phrases and terms that students might search when doing academic work and ran a study to identify terms associated with interest in taking shortcuts. We also considered the possibility that unequal states generate more searches for academic shortcuts simply because students there use the internet more for school-related work. Therefore, we identified terms associated with effortful learning strategies, and conducted parallel analyses using these terms. Materials and data for this study are available at osf.io/q3sa9/. Seventy-one raters recruited on Amazon Mechanical Turk rated the likelihood that each term would be used by a student when they a) wanted to work hard at

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learning (effortful learning searches) and b) when they wanted to find a low-effort shortcut (shortcut searches). Responses were on a 5-point Likert scale from 1 (*Very unlikely*) to 5 (*Very likely*). Shortcut terms were selected if they were strongly and uniquely associated with looking for a low-effort shortcut, determined by the magnitude and direction of the ratings difference score. We first excluded terms that had average shortcut ratings below the midpoint or average effortful learning ratings above the midpoint. We then selected the thirteen terms with the largest difference in ratings (a mean difference of at least one). These terms were: “how to cheat”; “scantron cheat”; “free term paper”; “fake doctors note”; “cheathouse”; “free research paper”; “answer key”; “worksheet answers”; “corrupt a file”; “equation solver”; “cliff notes”; “test banks”; “sparknotes.” Then the thirteen search terms most uniquely related to looking for ways to work hard at learning were selected. These terms were: “how to take notes”; “how to cite”; “study tips”; “thesaurus”; “khan academy”; “discussion questions”; “how to memorize”; “research paper ideas”; “coursera”; “quizlet”; “scholarpedia”; “lab report example”; “EdX.” In February of 2016, search frequencies for each shortcut term and each effortful learning term were obtained and averaged together to create a shortcut search frequency ($\alpha = 0.85$) and an effortful learning search frequency ($\alpha = 0.70$) for each state. The search results were returned as standardized scores with means of zero. Composite search scores were centered prior to analysis because the mean of the composite scores was not exactly zero.

Academic outcomes captured both standardized test performance and educational attainment. Performance was measured using publicly available data on standardized test scores on the NAEP from the National Center for Education Statistics. Standardized tests in the United States are not administered every year, and are not always administered to students in every state for every subject or age. Tests in Math and Reading are given most consistently, therefore we selected these scores. Because we did not have subject-specific hypotheses, we averaged scores on these tests. Our measures of performance are the average Math and

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Reading scores of 4th graders ($\alpha = .985$) and those of 8th graders ($\alpha = .989$) from 2005, 2007, 2009, 2011, 2013, and 2015. Educational attainment was measured by the percentage of adults over 25 who have attained a high school degree ($\alpha = .998$; U.S. Census Bureau, American Community Survey, 2005-2015). Our data source, the American Community Survey, contains many measures of educational attainment, which are highly correlated and often redundant. We chose to focus on high school graduation rates. High school graduation is a meaningful milestone that affects future earning potential.

Open Practices Statement

The analyses reported in this article were not formally preregistered. Early in the project, additional dependent variables and measures were analyzed for this article's target research question (e.g., Reading and Math NAEP scores individually, Vocabulary and Science NAEP scores, additional measures of educational attainment), and differently specified models were estimated (e.g., robustness checks that included an interaction between inequality and income). The final analysis plan was designed without specific knowledge of results. Analyses were limited to those presented to reduce the number of conducted analyses while using well-measured and practically meaningful dependent variables. The raw data, the script to create the analysis dataset, the analysis dataset, a dataset containing additional variables, and the script used to analyze the data and produce figures are available at <https://osf.io/jgzew/>.

Results

Analyses were conducted in R, using the package psych (Revelle, 2018). To test our hypothesis that the relationship between U.S. State inequality and academic outcomes owes in part to a shift in focus on short-term goals as expressed through students' use of low-effort shortcut strategies, we conducted tests of mediation. We also explored developmental differences by using three developmentally distinct educational outcomes: 4th grade performance, 8th grade performance, and high school graduation rates among adults over 25.

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For each outcome, we present up to four analyses, as summarized in Figure 3. First, examine shortcut search frequency as a mediator. We present a mediation analysis of the effect of Gini (mean-centered) on each educational outcome. If this mediation analysis showed a relationship between a) Gini and the educational outcome, and b) Gini and searching for shortcuts, we conducted additional analyses as robustness checks. We examined whether the effects we observed owe to state-level income rather than inequality by including per capita income (mean-centered) in the mediation analysis as another predictor. We also conducted analyses using alternative measures of inequality: the earnings ratios that compare the income of the richest in each state (90th to 50th percentile) and the poorest in each state to that state's average (50th to 10th percentile).

For all outcomes, we also examine effortful learning search frequency as a mediator. We do this in order to examine whether any effects of searching for shortcuts we observe can be better explained by a third variable related to internet use such as technology availability or general use of the internet to help with school work.

Fig 1.

U.S. States' standardized average 4th grade standardized test performance, 8th grade standardized test performance, and high school graduation rate by state-level inequality as measured by the Gini index of household income, $N = 50$. For each color-coded educational outcome, each dot represents a state.

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Fig 2.

U.S. States' Google search frequency for academic shortcut terms (left panel) and effortful learning terms (right panel) by state-level inequality as measured by the Gini index of household income, $N = 50$.

Fig 3.

A diagram showing the mediation analysis plan. For each outcome (4th grade performance, 8th grade performance, and adult educational attainment), we present up to four analyses. Shown in panel A, for all outcomes, we start with a mediation analysis where Inequality (mean-centered Gini index) is the predictor and shortcut search frequency is the mediator. For analyses suggesting mediation, shown in panels B and C respectively, we conduct the same mediation analysis with Income (mean-centered per capita income) as an additional predictor

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and a mediation analysis with earnings ratios (90th percentile: 50th percentile and 50th percentile: 10th percentile) as predictors. For all outcomes, shown in panel D, we conclude with a mediation analysis where Inequality (mean-centered Gini index) is the predictor and effortful learning search frequency is the mediator.

Table 1

Means, standard deviations, and correlations with confidence intervals

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8
1. Gini of household income	0.46	0.02								
2. Shortcut search rate	−0.00	0.59	.54** [.30, .71]							
3. 4 th grade performance	230.41	5.40	−.22 [−.47, .06]	−.33* [−.56, −.06]						
4. 8 th grade performance	273.19	6.14	−.34* [−.56, −.06]	−.50** [−.68, −.26]	.94** [.89, .96]					
5. Adult educational attainment	87.15	3.33	−.72** [−.83, −.55]	−.69** [−.81, −.51]	.64** [.44, .78]	.75** [.59, .85]				
6. Per capita income	26575.0 2	3785. 23	.01 [−.27, .29]	−.41** [−.61, −.14]	.57** [.35, .73]	.56** [.34, .73]	.44** [.18, .64]			
7. 50:10 income ratio	4.13	0.29	.72** [.55, .83]	.27 [−.01, .51]	−.08 [−.35, .20]	−.16 [−.42, .13]	−.40** [−.61, −.14]	.40** [.14, .61]		
8. 90:50 income ratio	2.68	0.16	.96**	.55**	−.30*	−.42**	−.79**	−.07	.68**	

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			[.93, .98]	[.32, .72]	[−.53, −.02]	[−.63, −.16]	[−.87, −.65]	[−.34, .21]	[.49, .80]	
9. Effortful learning search rate	0.00	0.46	−.17	.14	.26	.19	.16	.09	.01	−.16
			[−.42, .12]	[−.15, .40]	[−.02, .50]	[−.09, .45]	[−.12, .42]	[−.19, .36]	[−.27, .29]	[−.42, .12]

Note. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. * indicates $p < .05$. ** indicates $p < .01$. All variables are at the state level. Shortcut search rate is a mean-centered average of Google search frequencies of terms related to taking academic shortcuts. Effortful learning search rate is a mean-centered average of Google search frequencies of terms related to taking academic shortcuts. Performance scores of 4th and 8th graders are NAEP Math and Reading scores. Adult educational attainment is the rate of adults over 25 with a high school diploma.

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Table 2

Summary of mediation analyses using 4th grade performance as the criterion

Mediator	Predictor	<i>c</i>	<i>a</i>	<i>b</i>	<i>c'</i>	<i>ab</i>	Fit	Conclusion
Shortcut search rate								
	Gini	−63.50 [−142.25, 15.24]	16.71*** [9.27, 24.14]	−2.72 [−5.64, 0.20]	−18.03 [−109.17, 73.10]	−47.62 [−130.13, 7.34]	$R^2 = .11$ $F(2,47) = 2.97$	No mediation
Effortful learning search rate								
	Gini	−63.50 [−142.25, 15.24]	−4.05 [−10.87, 2.77]	2.77 [2.63, −0.58]	−52.85 [−131.41, 25.72]	−7.80 [−31.66, 14.89]	$R^2 = .10$ $F(2,47) = 2.58$	No mediation

Note. Mediation analysis results from two models with 4th grade performance (the average NAEP Math and Reading scores of 4th grade students) as the criterion. Path *c* is the estimated total effect of the predictor on the outcome, path *a* is the estimated effect of the predictor on the mediator, path *b* is the estimated effect of the mediator on the outcome, path *c'* is the estimated direct effect of the predictor on the outcome removing the mediator, and *ab* is the bootstrapped estimate of the indirect effect of the predictor on 4th grade performance through the mediator. Values in square brackets indicate the 95% confidence interval for each parameter estimate. * indicates $p < .05$. ** indicates $p < .01$ ***indicates $p < .001$.

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Table 3

Summary of mediation analyses using 8th grade performance as the criterion

Mediator	Predictor	<i>c</i>	<i>a</i>	<i>b</i>	<i>c'</i>	<i>ab</i>	Fit	Conclusion
Shortcut search rate								
	Gini	−109.29* [−195.81, −22.77]	16.71*** [9.27, 24.14]	−4.69** [−7.73, −1.64]	−31.0 [−125.84, 63.84]	−82.84 [−179.69, −15.29]	$R^2 = .26^{***}$ F(2,47) = 8.13	Mediation
	Gini	−111.15** [−181.09, −41.20]	16.84*** [10.27, 23.40]	−1.69 [−4.73, 1.35]	−82.73 [−169.30, 3.83]	−31.71 [−106.20, 21.90]		No mediation
	Income	.0009*** [.0006, .0013]	−.00006*** [−0.0001, −0.00003]	−1.69 [−4.73, 1.35]	.0008 [.0004, .00121]	.00012 [−.0001, 0.0004]	$R^2 = 0.45^{***}$ F(3,46) = 12.38	
	50:10 ratio	5.04 [−2.20, 12.28]	−0.38 [−0.38, −1.03]	−3.75* [−6.81, −0.69]	3.61 [−3.39, 10.60]	1.32 [−0.64, 3.80]		Mediation (90:50 only)
	90:50 ratio	−22.63** [−36.00, −9.26]	2.51*** [1.32, 3.70]	−3.75* [−6.81, −0.69]	−13.22 [−28.09, 1.65]	−9.59 [−20.97, −0.48]	$R^2 = .30^{***}$ F(3,46) = 6.49	
Effortful learning search rate								
	Gini	−109.29*	−4.05	1.86	−101.76*	−4.98		No mediation

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[-195.81, -22.77]	[-10.87, 2.77]	[-1.73, 5.45]	[-189.46, -14.06]	[-30.27, 17.42]	$R^2 = .13$ $F(2,47) = 3.58$
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Note. Mediation analysis results from two models with 8th grade performance (the average NAEP Math and Reading scores of 4th grade students) as the criterion. Path c is the estimated total effect of the predictor on the outcome, path a is the estimated effect of the predictor on the mediator, path b is the estimated effect of the mediator on the outcome, path c' is the estimated direct effect of the predictor on the outcome removing the mediator, and ab is the bootstrapped estimate of the indirect effect of the predictor on 8th grade performance through the mediator. Values in square brackets indicate the 95% confidence interval for each parameter estimate. * indicates $p < .05$. ** indicates $p < .01$ ***indicates $p < .001$.

Table 4

Mediator	Predictor	<i>c</i>	<i>a</i>	<i>b</i>	<i>c'</i>	<i>ab</i>	Fit	Conclusion	
Shortcut search rate									
		Gini	−126.13*** [−160.98, −91.27]	16.71*** [9.27, 24.14]	−2.44*** [−3.59, −1.30]	85.28*** [−120.89, −49.67]	−41.59 [−72.81, −17.93]	$R^2 = .64^{***}$ F(2,47) = 42.62	Mediation
		Gini	126.92*** [−154.02, −99.83]	16.84*** [10.27, 23.40]	−1.29* [−2.43, −0.16]	−105.14*** [−137.39, −72.89]	−21.70 [−45.80, −0.71]		Mediation
		Income	.00039*** [.00026, .00053]	−.00006*** [−.0001, −.00003]	−1.29* [−2.42, −0.16]	.00031*** [.0002, .0005]	.00008 [.000003, .00018]	$R^2 = 0.74^{***}$ F(3,46) = 43.53	
		50:10 ratio	2.79* [0.18, 5.39]	−0.38 [−1.03, 0.26]	−1.96*** [2.98, 0.93]	2.04 [−0.30, 4.38]	0.69 [−.30, 1.68]		Mediation
		90:50 ratio	−20.04*** [−24.85, −15.23]	2.51*** [1.32, 3.70]	−1.96*** [−2.98, −0.93]	−15.13 [−20.10, −10.16]	−4.91 [−8.81, −2.01]	$R^2 = 0.73^{***}$ F(3,46) = 42.32	(90:50 only)
Effortful learning search rate									

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Gini	-126.13*** [-160.98, -91.27]	-4.05 [-10.87, 2.77]	0.32 [-1.13, 1.78]	-124.81 [-160.45, -89.17]	-0.05 [-8.50, 11.04]	No mediation
						$R^2 = .51$ $F(2,47) = 24.83$

Note. Mediation analysis results from two models with adult educational attainment (the high school graduation rate of adults over the age of 25) as the criterion. Path c is the estimated total effect of the predictor on the outcome, path a is the estimated effect of the predictor on the mediator, path b is the estimated effect of the mediator on the outcome, path c' is the estimated direct effect of the predictor on the outcome removing the mediator, and ab is the bootstrapped estimate of the indirect effect of the predictor on adult educational attainment through the mediator. Values in square brackets indicate the 95% confidence interval for each parameter estimate. * indicates $p < .05$. ** indicates $p < .01$ ***indicates $p < .001$.

Performance of Fourth Graders

Shortcut search frequency as a mediator. For the youngest developmental group, 4th grade students, our hypotheses were not supported (see Table 2). There was no evidence of a total effect of Gini on 4th grade performance, a necessary condition of mediation (path c; $b = 63.5$, $se\ b = 40.18$, $t(47)=1.58$, $p = 0.121$). Thus, shortcut search frequency could not mediate this effect.

Effortful learning search frequency as a mediator. As with the above mediational analysis, there was no evidence of a total effect of Gini on 4th grade performance, so effortful learning search frequency could not mediate this effect (see Table 2).

Performance of Eighth Graders

Shortcut search frequency as a mediator. For 8th grade students, as summarized in Table 3, results were more consistent with our hypothesis. In the first model, with Gini alone, the total effect of Gini on performance was significant such that average scores on 8th grade Math and Reading were lower in more unequal states, $t(47)=-2.48$, $p = 0.017$. When accounting for the influence of shortcut search frequency, the direct effect of Gini on performance was no longer significant, $t(47)=-0.64$, $p = 0.52$. In support of a mediation hypothesis, the bootstrapped confidence interval around the estimated indirect effect of Gini through shortcut did not include zero.

In the second model focused on 8th grade performance, income was added as another predictor (see Table 3). The total of effect of Gini on performance was again significant, $t(46)=-3.11$, $p = 0.0032$, and the direct effect of Gini on performance removing shortcut was not significant when income was accounted for, $t(46)=-1.87$, $p = 0.067$. However, when accounting for income, the effect of shortcut search frequency on performance was not significant, and the estimate of the indirect effect of Gini on performance through shortcut was not distinguishable from 0. This model simultaneously estimated the mediation effects associated with income, and similarly found no evidence of mediation. The total effect of

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income on 8th grade performance was significant, $t(46)=5.14, p <.001$, as was the direct effect of income minus the effect of shortcut search frequency, $t(46)=3.97, p <.001$. The indirect effect of income through searching for shortcuts was not distinguishable from 0.

In the third model, income ratios were used as a measure of inequality. The ratio of median to low income earners (50:10) was not significantly related to performance, and thus shortcuts did not mediate the effect of this ratio on performance, $t(46) = 1.36, p = 0.179$. Results were different for the ratio of top to median earners (90:50), which was significantly negatively related to performance, $t(46) = -3.32, p = 0.002$. The direct effect of 90:50 ratios on performance was not significant when accounting for shortcut search frequency, $t(46) = -1.74, p = 0.088$. In support of a partial mediation hypothesis, the bootstrapped estimate of the indirect effect did not include zero in its confidence interval.

Effortful learning search frequency as a mediator. A model containing Gini alone did not suggest that effortful learning search frequency mediated the relationship between Gini and eighth grade performance (see Table 3). The effect of Gini on effortful learning search frequency, a necessary condition for mediation, was not significant (path a; $b = -4.05, se\ b = 3.48, t(48)=-1.16, p = 0.251$).

Educational Attainment of Adults

For adults over the age of 25, as summarized in Table 4, results are consistent with our hypotheses. In the first model, accounting for Gini alone, the total effect of inequality on high school graduation was significant, $t(47)=-7.09, p <.0001$. The direct effect of inequality accounting for shortcut search frequency was smaller, but still significant $t(47)=-4.69, p <.0001$. In support of a partial mediation hypothesis, the bootstrapped confidence interval of the estimated indirect effect did not include zero.

In the second model, income was accounted for. The total effect of Gini on high school graduation rates was again significant, $t(46) = -9.18, p <.0001$, and the direct effect was smaller but still significant, $t(46) = -6.39, p <.0001$. Consistent with a partial mediation

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hypothesis, the bootstrapped confidence interval of the indirect effect did not include zero.

The model simultaneously estimated the effects of income on high school graduation rate, and the results were the same; the total effect of income on high school graduation rate was significant, $t(46) = 5.7, p < .0001$, the direct effect accounting for searching for shortcuts was reduced but still significant, $t(46) = -6.39, p < .0001$. The bootstrapped confidence interval of the indirect effect of income through searching for shortcuts did not include zero, meaning that searching for shortcuts partially mediates the relationship between income and high school graduation rates.

In the third model, income ratios were used to capture inequality. The 50:10 ratio, which captures inequality of middle to low income earners, was marginally significantly related to high school graduation rates of adults, $t(46) = 2.10, p = 0.042$. The better a state's middle-income earners did than low-income earners, the higher the graduation rate (holding the 90:50 ratio constant). The direct effect of the 50:10 ratio on adult attainment was reduced to non-significance when accounting for shortcut search frequency, $t(46) = 1.71, p = 0.094$. There was no evidence that searching for shortcuts mediated the relationship between the 50:10 earnings ratio and adult attainment, as the bootstrapped confidence interval around the indirect effect included zero. The direct effect of the 90:50 ratio, which captures inequality related to the presence of extreme relative wealth, on adult attainment was significant, $t(46) = -8.16, p < .001$. When searching for shortcuts was accounted for, the direct effect was significant, though slightly reduced, $t(46) = -5.97, p < .001$. In contrast to the results associated with the 50:10 ratio and consistent with a partial mediation hypothesis, the bootstrapped confidence interval of the indirect effect of the 90:50 ratio on adult attainment through shortcuts did not include zero.

Effortful learning search frequency as a mediator. As with eighth grade outcomes, the model containing Gini alone did not suggest that effortful learning search frequency mediated the relationship between Gini and adult attainment (see Table 4). The effect of Gini on

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effortful learning search frequency, a necessary condition for mediation, was not significant (path a ; $b = -4.05$, $se\ b = 3.48$, $t(48) = -1.16$, $p = 0.251$).

Discussion

We investigated a potential psychological and behavioral cause for the relationship between inequality and poor academic outcomes. Assuming that subjective feelings of need elicit a potentially adaptive response to value short-term over long-term concerns, we hypothesized that increased use of academic shortcuts may contribute to the poor academic outcomes of unequal U.S. states. Specifically, we hypothesized that students in more unequal states would be more interested in taking shortcuts, and that the relative Google search frequency for academic shortcuts in a state would statistically mediate associations between the state's income inequality and its educational outcomes. We took a developmental approach, exploring whether educational outcomes would be differentially associated with both inequality and shortcut search frequency for younger developmental groups.

We found that among U.S. states, Gini was related to the academic performance of 8th grade students and the high school graduation rates of adults over the age of 25. We did not find a relationship between Gini and the performance of 4th grade students. In addition, the evidence for the role of academic shortcuts as a mediator of the association between income inequality and academic performance was stronger for adults than for 8th grade students.

The developmental pattern we found is consistent with the argument that inequality's effects on educational outcomes are psychologically and behaviorally mediated. Structural effects (e.g., state-level policies affecting teacher compensation) should similarly impact 4th graders and older learners. However, the described psychological effects of inequality may differentially impact developmental groups. Unlike 8th graders and adults, 4th graders are less likely to be aware of regional inequality and less likely to have control over academic decisions and behaviors. Furthermore, a psychological and behavioral bias towards

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optimizing short-term outcomes to the detriment of long-term outcomes should logically manifest as worse long-term outcomes, and should accrue as time passes.

Our hypothesis that searching for shortcuts would partially mediate relationships between inequality and educational outcomes was supported, but not without caveat. For 8th grade students, there was no longer evidence for partial mediation after accounting for income: shortcut search frequency was not related to 8th grade performance, and there was no evidence of an indirect effect of Gini through shortcut search frequency. When income ratios were used as a measure of inequality, results suggested that only the presence of high-income earners (90:50 ratio) was associated with 8th grade performance. This effect was partially mediated by shortcut search frequency. For adult educational attainment, the relationship between Gini and high school graduation rate was partially mediated by shortcut search frequency, even when accounting for income. As with 8th grade outcomes, the ratio of high to middle income earners (90:50 ratio) was associated with adult attainment, and this association was mediated by shortcut search frequency. The ratio of middle to low income earners (50:10 ratio) was associated with adult attainment, but not shortcut search frequency. For all developmental groups, search rates for words related to effortful learning did not mediate any of the relationships between inequality and educational outcomes, ruling out the possibility that searching for shortcuts is a proxy for internet use frequency.

Several hypothesis-inconsistent aspects of our results warrant consideration. Inequality was associated with increased searching for shortcuts, even after controlling for income, but so too was income, over and above inequality. Second, searching for shortcuts mediated the influence of income on high school graduation rates. Finally, accounting for income reduced the indirect effect of inequality on 8th grade performance to a non-significant level. Our results do not clearly delineate the mechanics of these relationships, and indeed they cannot. Because our measures were neither manipulated nor longitudinal, no analysis can establish the direction or causal nature of the covariation between income, inequality, search for shortcuts

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and academic outcomes (MacCallum, Wegener, Uchino, & Fabrigar, 1993). Furthermore, our statistical power was limited. Thus, our null results may be the result of true null effects, but they may also be false negatives due to our small sample size. However, our sample represents an entire population and thus produces stable parameter estimates by definition, though ones that cannot be assumed to generalize beyond the US.

With these limitations as context, there are at least two novel conclusions that our results support. First, people in more unequal states may be more inclined to search and presumably take academic shortcuts in ways that undermine their learning and educational attainment. We replicated and extended a previously published finding that inequality was positively related to rates of searching for words related to academic dishonesty (Neville, 2012). Whereas that work examined only searches related to cheating (e.g., “free term papers”) we found the same effects with a broader range of terms related to shortcuts, such as “equation solvers” and “worksheet answers,” that were selected on the basis of objective ratings and that may or may not be used dishonestly. We also show that: 1) these effects are not due to the general use of the internet for educational purposes, and 2) shortcut search frequencies are associated with actual educational outcomes. We interpret the increased shortcut search frequency in unequal states as a manifestation of a propensity towards maximizing short-term benefits at the expense of long-term benefits, and conclude this increased propensity may be one reason why state-level inequality is associated with poor educational outcomes.

Second, the effects of inequality on educational outcomes may be specifically driven by the presence of extreme wealth rather than extreme poverty. Using earnings ratios, we found that the ratio of the 90th percentile to the 50th percentile was associated with educational outcomes, but not the ratio of the 50th percentile to the 10th. Associations between the 90:50 ratio and educational outcomes were mediated by shortcut search frequency.

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Inequality can perpetuate itself in non-obvious ways. The psychological and behavioral consequences of inequality may undermine students' capacity to diligently complete their work. What can be done to interrupt this cycle? It is possible that educators can structure assignments to scaffold students' planning and self-regulation, or impose deadlines in ways that benefit subsequent performance (Ariely & Wertenbroch, 2002; Lodewyk, Winne, & Jamieson-Noel, 2009). In addition, students' focus on short versus long-term outcomes is an excellent candidate for a "wise intervention" (Walton, 2014). To prevent school from worsening inequality, stakeholders should seek to further identify, understand, and disrupt psychological and behavioral causes of academic under-achievement in unequal regions.

References

- Adelman, R. M., Herrmann, S. D., Bodford, J. E., Barbour, J. E., Graudejus, O., Okun, M. A., & Kwan, V. S. Y. (2017). Feeling closer to the future self and doing better: Temporal psychological mechanisms underlying academic performance. *Journal of Personality*, 85(3), 398–408. <https://doi.org/10.1111/jopy.12248>
- Andersen, R., & Curtis, J. (2012). The polarizing effect of economic inequality on class identification: Evidence from 44 countries. *Research in Social Stratification and Mobility*, 30(1), 129–141. <https://doi.org/10.1016/j.rssm.2012.01.002>
- Baldus, B., & Tribe, V. (2008). The development of perceptions and evaluations of social inequality among public school children. *Canadian Review of Sociology/Revue Canadienne de Sociologie*, 15(1), 50–60. <https://doi.org/10.1111/j.1755-618X.1978.tb00570.x>
- Callan, M. J., Shead, N. W., & Olson, J. M. (2011). Personal relative deprivation, delay discounting, and gambling. *Journal of Personality and Social Psychology*, 101(5), 955–973. <https://doi.org/10.1037/a0024778>
- Cheung, F., & Lucas, R. E. (2016). Income inequality is associated with stronger social comparison effects: The effect of relative income on life satisfaction. *Journal of Personality and Social Psychology*, 110(2), 332–341. <https://doi.org/10.1037/pspp0000059>
- Chiu, M. M. (2007). Families, economies, cultures, and science achievement in 41 countries: Country-, school-, and student-level analyses. *Journal of Family Psychology*, 21(3), 510–519. <https://doi.org/10.1037/0893-3200.21.3.510>

INEQUALITY AND ACADEMIC SHORTCUTS

- Duckworth, A. L., & Seligman, M. E. P. (2005). Self-discipline outdoes IQ in predicting academic performance of adolescents. *Psychological Science*, 16(12), 939–944.
<https://doi.org/10.1111/j.1467-9280.2005.01641.x>
- Fajnzylber, P., Lederman, D., & Loayza, N. (2002). Inequality and violent crime. *The Journal of Law and Economics*, 45(1), 1–39. <https://doi.org/10.1086/338347>
- Hartwig, M. K., & Dunlosky, J. (2012). Study strategies of college students: Are self-testing and scheduling related to achievement? *Psychonomic Bulletin & Review*, 19(1), 126–134. <https://doi.org/10.3758/s13423-011-0181-y>
- Hsieh, C.-C., & Pugh, M. D. (1993). Poverty, income inequality, and violent crime: A meta-analysis of recent aggregate data studies. *Criminal Justice Review*, 18(2), 182–202.
<https://doi.org/10.1177/073401689301800203>
- Joireman, J. A. (1999). Additional evidence for validity of the Consideration of Future Consequences Scale in an academic setting. *Psychological Reports*, 84(3_suppl), 1171–1172. <https://doi.org/10.2466/pr0.1999.84.3c.1171>
- Kearney, M., & Levine, P. (2014). *Income Inequality, Social Mobility, and the Decision to Drop Out of High School* (No. w20195). Cambridge, MA: National Bureau of Economic Research. <https://doi.org/10.3386/w20195>
- King, R. B., & McInerney, D. M. (2014). The work avoidance goal construct: Examining its structure, antecedents, and consequences. *Contemporary Educational Psychology*, 39(1), 42–58. <https://doi.org/10.1016/j.cedpsych.2013.12.002>
- Kirby, K. N., Winston, G. C., & Santiesteban, M. (2005). Impatience and grades: Delay-discount rates correlate negatively with college GPA. *Learning and Individual Differences*, 15(3), 213–222. <https://doi.org/10.1016/j.lindif.2005.01.003>

INEQUALITY AND ACADEMIC SHORTCUTS

- Kondo, N., Sembajwe, G., Kawachi, I., van Dam, R. M., Subramanian, S. V., & Yamagata, Z. (2009). Income inequality, mortality, and self rated health: meta-analysis of multilevel studies. *BMJ*, 339(nov10 2), b4471–b4471. <https://doi.org/10.1136/bmj.b4471>
- Kraus, M. W., Park, J. W., & Tan, J. J. X. (2017). Signs of social class: The experience of economic inequality in everyday life. *Perspectives on Psychological Science*, 12(3), 422–435. <https://doi.org/10.1177/1745691616673192>
- MacCallum, R. C., Wegener, D. T., Uchino, B. N., & Fabrigar, L. R. (1993). The problem of equivalent models in applications of covariance structure analysis. *Psychological Bulletin*, 114(1), 185–199. <https://doi.org/10.1037/0033-2909.114.1.185>
- Malka, A., & Covington, M. V. (2005). Perceiving school performance as instrumental to future goal attainment: Effects on graded performance. *Contemporary Educational Psychology*, 30(1), 60–80. <https://doi.org/10.1016/j.cedpsych.2004.04.001>
- Neville, L. (2012). Do economic equality and generalized trust inhibit academic dishonesty? Evidence from state-level search-engine queries. *Psychological Science*, 23(4), 339–345. <https://doi.org/10.1177/0956797611435980>
- Payne, B. K., Brown-Iannuzzi, J. L., & Hannay, J. W. (2017). Economic inequality increases risk taking. *Proceedings of the National Academy of Sciences*, 114(18), 4643–4648. <https://doi.org/10.1073/pnas.1616453114>
- Peters, B. R., Joireman, J., & Ridgway, R. L. (2005). Individual differences in the consideration of future consequences scale correlate with sleep habits, sleep quality, and GPA in university students. *Psychological Reports*, 96(3), 817–824. <https://doi.org/10.2466/pr0.96.3.817-824>

INEQUALITY AND ACADEMIC SHORTCUTS

- Ramsey, P. G. (1991). The salience of race in young children growing up in an all-White community. *Journal of Educational Psychology*, 83(1), 28–34.
<https://doi.org/10.1037/0022-0663.83.1.28>
- Revelle, W. (2018) psych: Procedures for Personality and Psychological Research, Northwestern University, Evanston, Illinois, USA, <https://CRAN.R-project.org/package=psych> Version = 1.8.10.
- Shah, A. K., Mullainathan, S., & Shafir, E. (2012). Some consequences of having too little. *Science*, 338(6107), 682–685. <https://doi.org/10.1126/science.1222426>
- Shah, Anuj K., Shafir, E., & Mullainathan, S. (2015). Scarcity frames value. *Psychological Science*, 26(4), 402–412. <https://doi.org/10.1177/0956797614563958>
- Shell, D. F., & Husman, J. (2001). The multivariate dimensionality of personal control and future time perspective beliefs in achievement and self-regulation. *Contemporary Educational Psychology*, 26(4), 481–506. <https://doi.org/10.1006/ceps.2000.1073>
- Sigelman, C. K. (2012). Rich man, poor man: Developmental differences in attributions and perceptions. *Journal of Experimental Child Psychology*, 113(3), 415–429.
<https://doi.org/10.1016/j.jecp.2012.06.011>
- Sigelman, C. K. (2013). Age differences in perceptions of rich and poor people: Is it skill or luck?: Skill or luck? *Social Development*, 22(1), 1–18.
<https://doi.org/10.1111/sode.12000>
- Simons, J., Dewitte, S., & Lens, W. (2003). “Don’t do it for me. Do it for yourself!” Stressing the personal relevance enhances motivation in physical education. *Journal of Sport and Exercise Psychology*, 25(2), 145–160. <https://doi.org/10.1123/jsep.25.2.145>

INEQUALITY AND ACADEMIC SHORTCUTS

- Simons, J., Vansteenkiste, M., Lens, W., & Lacante, M. (2004). Placing motivation and future time perspective theory in a temporal perspective. *Educational Psychology Review*, 16(2), 121–139. <https://doi.org/10.1023/B:EDPR.0000026609.94841.2f>
- Subramanian, S. ., Kawachi, I., & Kennedy, B. P. (2001). Does the state you live in make a difference? Multilevel analysis of self-rated health in the US. *Social Science & Medicine*, 53(1), 9–19. [https://doi.org/10.1016/S0277-9536\(00\)00309-9](https://doi.org/10.1016/S0277-9536(00)00309-9)
- Tudor, J. F. (1971). The development of class awareness in children. *Social Forces*, 49(3), 470–476. <https://doi.org/10.1093/sf/49.3.470>
- U.S. Census Bureau, American Community Survey 1-Year Estimates. (2006-2015). *Gini Index of income inequality*. Retrieved from <https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t>
- U.S. Census Bureau, American Community Survey 1-Year Estimates. (2005-2015). *Per capita income in the past 12 months (in inflation-adjusted dollars)*. Retrieved from <https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none>
- U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP). (2005, 2007, 2009, 2011, 2013, and 2015). *Mathematics assessments*. Retrieved from <https://www.nationsreportcard.gov/ndecore/landing>
- U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP). (2005, 2007, 2009, 2011, 2013, and 2015). *Reading assessments*. Retrieved from <https://www.nationsreportcard.gov/ndecore/landing>

INEQUALITY AND ACADEMIC SHORTCUTS

Walasek, L., & Brown, G. D. A. (2015). Income inequality and status seeking: Searching for positional goods in unequal U.S. States. *Psychological Science*, 26(4), 527–533.

<https://doi.org/10.1177/0956797614567511>

Walton, G. M. (2014). The new science of wise psychological interventions. *Current Directions in Psychological Science*, 23(1), 73–82.

<https://doi.org/10.1177/0963721413512856>

Wilkinson, R. G., & Pickett, K. (2010). *The spirit level: why greater equality makes societies stronger* (1. American ed., rev. and updated). New York, NY: Bloomsbury Press.

Wilkinson, R. G., & Pickett, K. E. (2007). The problems of relative deprivation: Why some societies do better than others. *Social Science & Medicine*, 65(9), 1965–1978.

<https://doi.org/10.1016/j.socscimed.2007.05.041>

INEQUALITY AND ACADEMIC SHORTCUTS