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Does inequality erode cooperation in the classroom? Evidence from PISA 2015

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DOES INEQUALITY ERODE COOPERATION IN THE CLASSROOM? EVIDENCE FROM PISA 2015

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Overview: *We consider the relationship between SES equality and cooperation among high school students. We find that inequality decreases the acquisition of cooperation skills, a key ingredient to sustained democracy. Generalized trust and political equality counteract this effect independently. Further, trust and political equality moderate the influence of inequality, reaffirming the importance of education to democratic citizenship.*

Robert Axelrod poses a fundamental question regarding the functioning of modern societies: "Under what conditions will cooperation emerge in a world of egoists without central authority" (1984, 1)? Locating those conditions allows individuals, who work together to achieve common ends, to more fully realize their self-interests while foregoing the costs associated with centralized decision-making. Attraction to the concept of social capital has been in large part because of its potential to facilitate cooperative behavior toward the functioning of democratic institutions (Coleman and Ferejohn 1986; Putnam 1993). The ability to achieve cooperation when addressing collective action problems, for example in production and maintenance of local public goods, is a determinant of economic performance (Banderia et al. 2005; Zak and Knack 2001). In fact, cooperation is embedded in the fabric of daily life with groups that include families, schools, work places, and voluntary associations to name but a few.

John Dewey stressed the importance of learning cooperative behavior at a formative age, and he identified schools as the ideal setting for students to learn to cooperate. In addition to achieving academic skills, the classroom is a place where students learn to relate to each other and internalize the importance of cooperation (Dewey 1916). However, cooperative behavior, as a student learning goal, challenges school systems to commit adequate resources toward this goal in a context of competing financial and pedagogical pressures (Slavin et al. 1985). Beyond school-level constraints, a greater challenge to students attaining a cooperative aptitude may be the environment within which schools operate. Our concern is with one aspect of that environment: socio-economic inequality and the extent to which it may influence cooperation as an educational outcome.

In the next section, we consider the consequences of inequality, especially as it relates to student learning outcomes. We then develop a model, using data from the Programme for International Student Assessment (PISA), that estimates the impact that exposure to socio-economic inequality has on cooperative behavior as a skill linked to academic achievement. The model considers several levels of exposure including income disparities among students in the classroom, across schools within the educational system, and national-level indicators of inequality among households.

Inequality and Academic Achievement

When considering the development of cooperation skills within formal educational settings, we take our cues from a wealth of scholarly energy that has investigated the positive relationship between socioeconomic status (SES) and academic achievement. In a meta-analysis of the field, Sirin notes that SES is probably the most used contextual variable in education research (2005, 417). Although the literature sees different conceptualizations of socio-economic status, most rely on individual-based measures that are represented by, or incorporate some combination of, family income, parental education levels, and parents' occupations coded for status (Lindberg et al. 2010).

Controlling for other demographic characteristics, the SES background of students reliably contributes to explaining variance in academic achievement, yet, the strength of the effect shows significant variance cross-nationally (Else-Quest et al. 2010; OECD 2017a, 175). The SES effect

also varies with the age of a student. Caro et al. (2009) find that an achievement gap across SES categories in Canada is present but stable, and relatively small, between ages seven and eleven. Yet, from 12 to 15 years old, the academic achievement gap increasingly widens, with the average gap ultimately twice as large among students in this older age group compared to the younger group. They attribute the difference to the "cumulative advantage theory" of SES, which maintains that with age, the advantages grow exponetially for those in high status groups, while individuals in other groups others remain relatively stable levels across the formative to adolescent years.

Although contributing to our understanding, relying on individual demographic information provides a limited explanation for the variance observed. Multilevel approaches that take into account variance across schools, districts, and countries provide additional explanatory power. Possibly, the combination of environmental factors may vary across countries with individual socio-economic status driving results in some countries, and school characteristics providing a better explanation in others (Martins and Veiga 2010). Reyes and Stanic (1988) recognize that individual demographics are important, focusing on the effects of race, but they also point our attention to *processes* in the classroom, such as teacher attitudes and curricular goals. Whereas, Perry and McConney (2010) find that SES on the individual level positively impacts academic achievement. As SES increases in a school, all student scores increase, statistically speaking. Thus, mean SES levels at a school may have a positive effect on academic achievement. However, like many studies, the effect of the distribution (standard deviation) of SES levels is not tested.

The particular school you attend can make a difference regarding academic achievement outcomes; moreover, the economic, social, and cultural status (ESCS), as a composite index of a school, produces a significant effect as a moderating factor (OECD 2014). Karakolidis et al. (2016) find that the ESCS index holds significance in shaping mathematic achievement in Greece with student individual-level demographics having independent effects. Marks (2006) looks at the extent to which individual SES differences explain within school and across school differences in academic outcomes, finding that they do not. He concludes that institutional and system factors better account for the variance in student performance. However, he does not consider "exposure" to SES differences measured through standard deviations of income. In fact, multilevel studies that consider the SES differences on a school level tend to evaluate absolute, but not relative, levels of inequality.

The extent to which SES effects operate at the level of neighborhood or school district has been another avenue of inquiry. Sastry and Pebley (2010) estimate the effect of neighborhood wealth (median) and the relative concentration of wealth (lowest and highest quartiles of income). They find that student characteristics explain outcomes, with parental education having the greatest effect. The income level of a neighborhood also adds to their explanation, but the concentration of wealth, or the extent to which a community has income diversity, was not a statistically significant factor in their models. A different way of conceptualizing community-level variance is to consider rural – urban differences in academic achievement with urban settings correlating to higher achievement scores than rural settings (Lounkaew 2013).

A more common approach has been a cross-national design that employs aggregate measures to evaluate exposure to inequality. Baker et al. (2002), for example, focus on national measures of inequity, estimating the extent to which national economic development influence academic achievement. They find that as an economy develops, income gaps initially rise, and with that,

students reproduce their position within society as measured through family SES status. Thus, we see a direct link between economic disparity and academic achievement measured through mathematics and science scores, and this holds for most countries. Marks et al. (2007) derive similar findings, drawing a link between status and academic achievement, however, they conclude that cultural factors play a larger role in the outcome as opposed to levels of inequality.

Inequality also has been shown to have a negative effect on generalized trust, which in turn is likely to influence academic achievement. The theoretical premise behind the negative link between economic inequality and trust is that inequity builds walls among socioeconomic classes. The values that bind those in the lower economic rungs diverge from those at the top, and the absence of shared values breeds suspicion (Uslaner and Brown 2005). A number of studies show that the impact of diversity on trust is at local level where individuals experience it. For example, in the United States levels of generalized trust in mixed-race neighborhoods tend to be lower than in areas that are more homogeneous, but only when measures of local income distribution are included within the analysis (Alesina and La Ferrara 2005). Also, by using national survey data of Romanian high school students, we found that exposure to socioeconomic diversity within the classroom erodes trust, even when controlling for inequalities that may be present in the broader community (Sum and Badescu 2018).

At the same time, generalized trust has been shown to be a strong predictor of cooperation. Two mechanisms can be considered to underlie the correlation between generalized trust and cooperation. The first mechanism relates to the fact that generalized trust may be an alternative way to assess trustworthiness or a shortcut to information on trustworthiness. Hence, it is argued to be a stereotypic perception of other people invoked when information on their trustworthiness is hard to discern, and, as a result, those with high trust are more likely to cooperate than low trusters when no information on the other players is available (Sonderskov 2011; Petersen, 2009; Holm and Danielson; Yamagishi, 2001). The second mechanism rests on the assumption that most humans are conditional cooperators, which means that when faced with social dilemmas they are guided by the social exchange heuristic, which motivates them to cooperate when they expect others to do likewise (Sonderskov 2011). More generally, people who trust rely on greater information processing abilities, which are required in order to perform better at the problem-solving task represented by social interactions (Yamagishi, 2001). Therefore, we expect those with high levels of trust to be able to perform better in school compared to their less trusting colleagues.

Research Design

Our purpose is to assess the impact that exposure to SES inequality has on attainment of cooperation skills among youth. Our central hypothesis is based on the theoretical premises behind the negative link between economic inequality and generalized trust, and the positive link between trust and cooperation.

H1. Inequality has a negative effect on cooperation.

We also expect that contextual factors will influence this negative relationship. We are interested in two possible moderating effects. The first is political equality. Evidence exists to show that political democracy is not related to the level of economic equality within a society (Bollen and

Jackman 1985). However, other evidence suggests that democratic decision-making engenders higher rates of cooperation, in part because actors feel they had a fair opportunity to have input in the process (Dal Bó et al. 2010).

Theoretically, cooperation and democracy are symbiotically related, with a cooperative disposition being an important ingredient to making democracy work. Tocqueville (2003) greeted the advent of mass political enfranchisement with suspicion, fearing a tyranny of the majority. For him, civil society stood the best chance of safeguarding individuals from this potential, but associational life requires individuals to cooperate, and that cooperation is predicated on political equality. This logic guides our second hypothesis regarding the moderating potential of political equality.

H2. Political equality alleviates the effects of inequality on cooperation.

Generalized trust, which refers to the faith one holds in strangers, especially those who are different, is also associated with cooperation (Uslaner 2002). Dovetailing with the importance of political equality, generalized trust forms the foundation of social capital, based on the perception of commonly held values (Marschall and Stolle 2004; Putnam 2000). Having faith in people who you do not know encourages cooperative behavior making it easier to overcome collective action problems (Coleman 1990; Colquitt, et al. 2007; Newton 1999). By reducing social ambiguity, trust facilitates contingent and complex decision-making that relies on cooperation (Shapiro 1987). Our third hypothesis considers the moderating role that trust likely plays with regard to the relationship between SES inequality and student acquisition of cooperative skills:

H3. High trust at society level alleviates the effects of inequality on cooperation.

We evaluate these hypotheses using data from the Programme for International Student Assessment (PISA). Collected by the OECD, PISA is the largest international education study in the world, applied every three years, to 15-year old students in the form of a two-hour standardized test. We use the latest iteration of PISA data, collected in 2015. The sample size exceeds 500,000 students and represents a population of over 28 million students in 68 countries. The 2015 data includes results from reading, math, and science tests as well as a new assessment of student collaborative problem solving, which was applied in 47 of the countries that participated in 2015 (OECD 2017b, 24-25).

We measure cooperation using results from the collaborative problem-solving competency. PISA defines this as the capacity of an individual to effectively engage in a process whereby two or more agents attempt to solve a problem by sharing the understanding and effort required to come to a solution and pooling their knowledge, skills, and efforts to reach that solution (OECDb 2017, 26). PISA measures three interrelated competencies for collaborative problem-solving: 1) establishing and maintaining shared understanding, 2) taking appropriate action to solve the problem, and 3) establishing and maintaining team organization. The process through which a student is assessed is as follows:

> In the PISA assessment, one agent is the student whose performance is being evaluated; all other agents are computerized simulations. This allows the assessment to control the behaviour of the other agents in order to isolate the collaborative problem-solving ability of the student being evaluated. Had the student been in a group with other students, his or

> her performance would have depended on the ability of the other students and the pre-existing relationships between them. All questions in the assessment were either multiple choice or involved moving icons into the appropriate slot; there were no free-response questions. Since it was an interactive assessment, students were required to respond to each question before moving onto the next and could not skip or omit questions. Collaboration was assessed through students' responses in their interactions with computer-based agents (OECD 2017b, 32).

The PISA design is highly complex and the use of multiple plausible values is the recommended method for analysis (Davier et al. 2009). One of the benefits of this method is that although relatively few students, less than 10 percent of all, responded to all three domains, they have individual scores imputed for each domain. However, the validity of some of the assumptions on which plausible values are built have been contested. Kreiner and Christensen (2014) studied invariance across subscales on PISA 2006 data and found evidence of a misfit of the PISA scaling model and strong evidence of differential item functioning (DIF). In addition, it seems that the imputation inflates the correlations between the measures of subjects and, as a result, makes harder to identify determinants of their difference.

Because of these concerns, we based our analyses on a simpler measure. The Cooperation index computes scores as proportions of correct answers for a student out of the total. In addition, we included in our models the PISA Science academic achievement index. The Science index was applied to all students in 2015 (compared to 50 percent for Mathematics and 50 percent for Reading).

Our measures of inequality are also derived from the 2015 PISA data set. In addition to competency data, students are asked to complete a survey that includes demographic information, including income. We take the standard deviation of the mean household income for each school to measure the school inequality. Thus, we measure SES differences to which students are directly exposed at school. We also estimate inequality across schools, which is the standard deviation of the school means for each country. The resulting measure is national in scope and refers to an indirect exposure to inequality. Inequality across schools refers only to the population of families with 15-year old students, and thus deviates from alternative national measures, such as the Gini coefficient.

To estimate political equality as a moderating variable represented in our second hypothesis, we employ a measure developed by the *Democracy Barometer Project*. Political equality is an index that includes three elements: transparency, participation, and representation. This means that all citizens are treated as equals in the political process, have equal rights to influence decision-making, and have equal access to political power (http://www.democracybarometer.org/concept_en.html). Our model also includes interaction terms between political equality and both measures of inequality.

For generalized trust, we turn to the World Values Surveys which ask citizens worldwide if they think that most people can be trusted or if you can't be too careful these days. Thus, respondents confront an "either – or" question. We use the percentage of national samples who responded that most people can be trusted (http://www.worldvaluessurvey.org/wvs.jsp). Like for political

equality, we include two interaction variables reflecting trust and in-school inequality as well as trust and inequality across schools.

Figure 1: Model for explaining cooperation

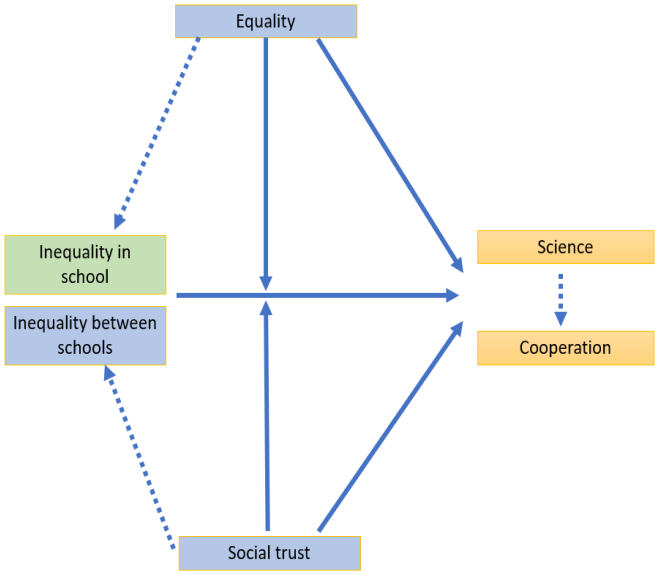


Figure 1 is a visual representation of our model. We run two iterations of the model, one with scores from the science competency and one without. The PISA collaborative problem-solving competency is strongly correlated with the other academic competencies of reading, mathematics, and science although its association with these three is not as strong as the correlation among the three (OECD 2017b, 34). We include two control variables within the model (not shown in Figure 1). PISA collects information about the involvement of parents and features of home life of students. *Home education resources* (HEDRES) is included to control for the effect these qualities may have on outcomes. We also control for country-level wealth.

Data Analysis

We begin the analysis by considering the correlations among our main variables in aggregate form. Table 1 shows the correlations between each of our main variables at a country level. "Inequality 1" represents the average SES inequality in the PISA student's school, while "inequality 2" is the SES inequality among schools within the country. Both are negatively associated with the cooperation competency while political equality and generalized trust show a positive correlation.

Table 1: Correlation among the primary variables at the country level

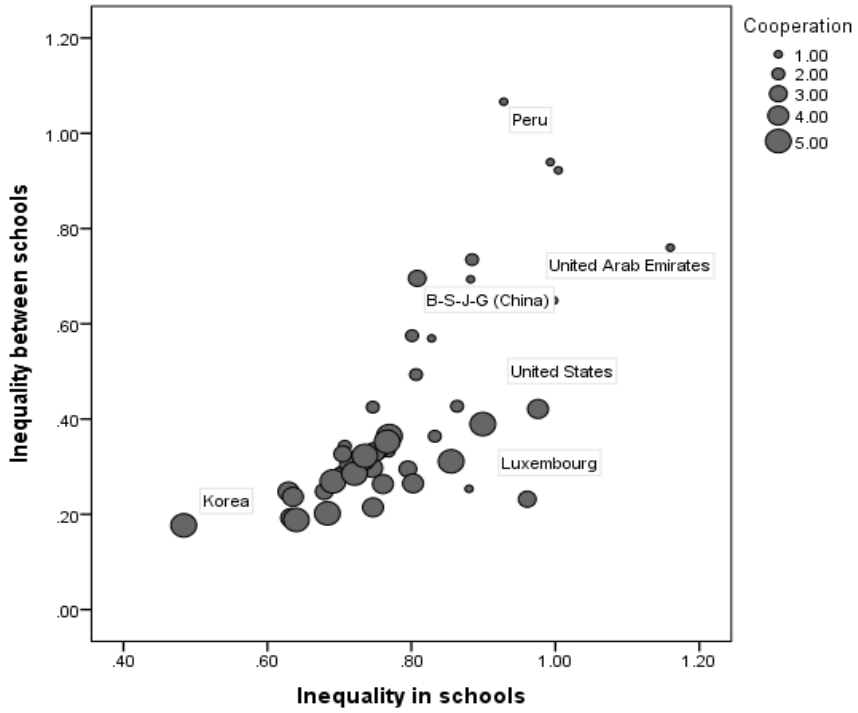
	In-school inequality	Inequality across schools	Generalized trust	Political Equality
Cooperation (PISA):	-.538***	-.659***	.587***	.716***

	(47)	(47)	(43)	(38)
In-school inequality:	--	.646*** (69)	-.306* (63)	-.322* (50)
Inequality across schools:	.646*** (69)	--	-.329** (63)	-.509*** (50)
Generalized trust:	-.306* (63)	-.329** (63)	--	.745*** (48)
Political equality:	-.322* (50)	-.509*** (50)	.745*** (48)	--

*** = p < .001; ** = p < .01; * = p < .05; (N)

Figure 2 shows visually the relationship between in-school inequality and across school inequality with relation to the relative achievement (in quintiles) on the PISA cooperation competency. The two types of inequality tend to correlate closely within a country, and collaborative problem-solving tends to be stronger in countries where greater equality prevails.

Figure 2: Two forms of inequality and cooperation competency among countries



Our main concern is how exposure to inequality impacts individual student outcomes with regard to gaining skills in cooperation. Table 2 shows the results from applying structural equation models (SEM) to the PISA data. We consider both cooperation and science competencies, with Model 3 including science competency as a predictor of cooperation.

Table 2: SEM multilevel models

	Model 1		**Model2**		**Model3**	
	Std. est.	p value	Std. est.	p value	Std. est.	p value
Cooperation~						
HEDRES	0.13	***	0.13	***	0.04	***
Inequality in school	-0.28	***	-0.28	***	-0.09	***
Inequality between schools	-0.18	***	-0.18	***	-0.15	***
Wealth (country level)	0.11	***	0.11	***	0.08	***
Political equality (DB)	-0.17	***	-0.17	***	-0.13	***
Trust	0.07	***	0.07	***	0.09	***
Pol equal. * Ineq. in school	0.10	***	0.10	***	0.02	.045
Pol equal. * Ineq. btw. schools	0.13	***	0.13	***	0.20	***
Trust * Ineq. in school	0.09	***	0.09	***	0.03	.027
Trust * Ineq. btw. schools	0.00	.723	0.00	.723	-0.06	***
Science					0.61	
Science~						
HEDRES	0.16	***	0.16	***	0.16	***
Inequality in school	-0.30	***	-0.30	***	-0.30	***
Inequality between schools	-0.04	***	-0.04	***	-0.04	***
Wealth (country level)	0.06	***	0.06	***	0.06	***
Trust	-0.03	***	-0.03	***	-0.03	***
Pol equality (DB)	-0.06	***	-0.06	***	-0.06	***
Pol equality * Ineq. in school	0.13	***	0.13	***	0.13	***
Pol equality * Ineq. btw. schools	-0.12	***	-0.12	***	-0.12	***
Trust * Ineq. in school	0.10	***	0.10	***	0.10	***
Trust * Ineq. btw. schools	0.09	***	0.09	***	0.09	***
Inequality1~						
Political equality			-0.33	***		
Trust			-0.16			
Inequality2~						
Political equality			-0.57	***		
Trust			-0.41	***		
	CFI=1.00, TLI=1.00 RMSEA=0.05		CFI=1.00, TLI=1.00 RMSEA=0.05		CFI=1.00, TLI=1.00 RMSEA=0.05	

In all three models, both types of inequality have a negative relationship to students' cooperation competency scores. In-school inequality has a stronger effect than inequality across schools in Models 1 and 2. The in-school effect decreases considerably in Model 3, which includes the science competency measure as a predictor of cooperation, although inequality across schools maintains a similar value. The finding suggests that there may be school-level attributes where a more traditional academic competency, "science" in our model, transfers to the cooperation

competency. For example, instructional methods or the approach to pedagogy are particularly effective in a school for all subjects and disciplines.

We also are interested in two possible moderating factors: political equality and generalized trust. Political equality produces an unexpected outcome. In all three models, political equality has a negative influence on cooperation competency scores. However, as an interaction term, political equality moderates the negative (direct) effects of both types of inequality. Thus, Table 2 provides some support for our second hypothesis.

The models show that trust has a positive direct effect on cooperation. This relationship is expected and consistent with findings in the literature on generalized trust. As an interactive term, trust moderates the negative effect that in-school inequality has on cooperation, lending some support for our third hypothesis. That effect does not extend to the interaction term of trust and across-school inequality.

Breaking down these moderating effects, Figures 3 – 6 show the relationship between each type of inequality and cooperation, with the moderating effects of political equality and generalized trust separated into dichotomies. Figure 3 shows the moderating effect of political equality. As equality decreases, cooperation scores also decrease. The difference in slopes between where political equality is higher or lower shows that the decrease is not as dramatic where transparency is higher, political participation is less encumbered, and representatives are relatively more response to citizen demands: the three components of our political equality measure. However, it is noteworthy that the intercept shows that where political equality is low, cooperation is higher when inequality within a school is low. Less open regimes that have higher equality within their schools have higher cooperation scores. As in-school inequality increases within the less politically equal contexts, we see that form of inequality has a more intense negative impact on cooperation.

Figure 4 shows how generalized trust moderates the relationship between cooperation competency and in-school equality. Here, the finding is more straightforward. Inequality negatively impacts cooperation, but cooperation is higher in more trusting countries, and this trust dividend expands as inequality within a school grows.

Figure 3: Cooperation and in-school inequality moderated by political equality

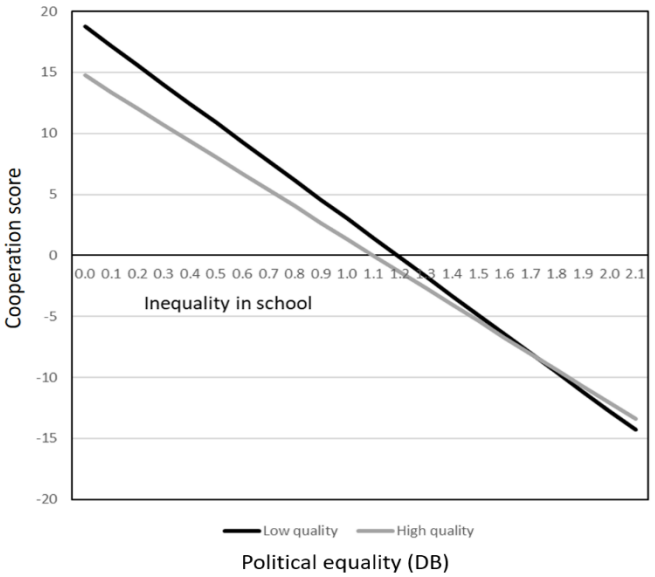
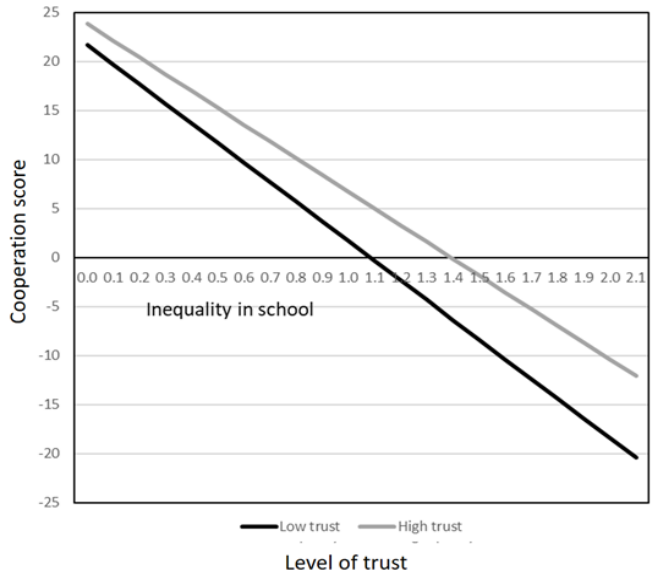


Figure 4: Cooperation and in-school inequality moderated by generalized trust



We next turn our attention to inequality across schools in a country. Figure 5 shows the moderating effect of political equality on the relationship between cooperation and equality across institutions. Here, the result departs from our expectations. For countries where political equality is low, inequalities across the school system has the expected negative result. However, for countries where political equality is high, inequality across schools is associated with higher cooperation competency scores.

Figure 5: Cooperation and inequality across schools moderated by political equality

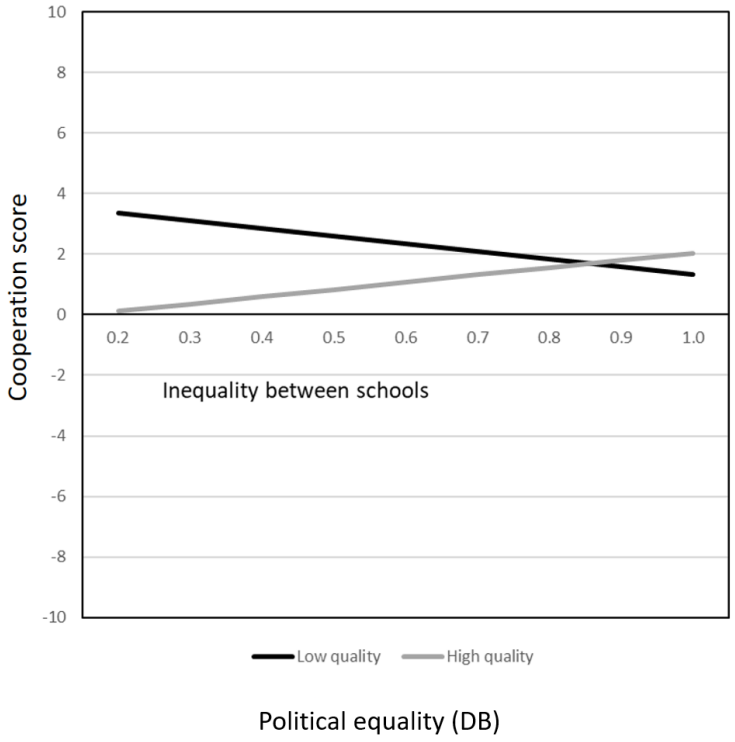


Figure 6: Cooperation and inequality across schools moderated by generalized trust

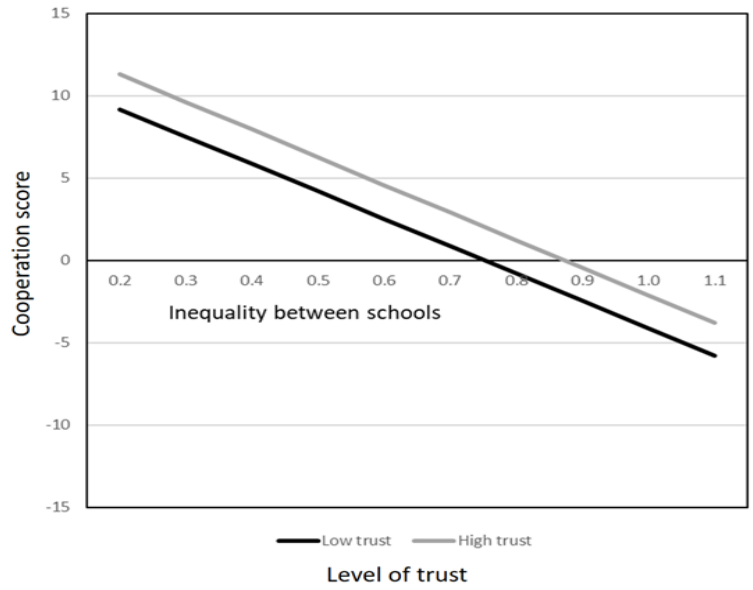


Figure 6 shows the moderating effect that generalized trust has on the relationship between cooperation and inequality across schools. The result is consistent with our third hypothesis. Countries with greater levels of generalized trust have students who consistently score higher in terms of the PISA collaborative problem-solving competency (cooperation) then students from

cases where faith in strangers is lower. The effect remains more or less proportional across levels of inequality experienced among schools within a country.

In sum, exposure to inequality has a negative impact on students' acquisition of cooperation skills. This result holds with direct exposure at the school level, as well as indirectly, when we consider equality among schools. The same holds true for competency in science. Students who do well in science also score higher on the cooperation measure suggesting that the two possess common elements that may range from higher cognitive abilities to effective standardized test-taking skills. Political equality has a positive effect on cooperation. Further, it moderates in-school inequalities, so that more open political systems see less of a dramatic negative effect on cooperation. However, where political equality is higher, cooperation scores are higher where inequality across schools is higher. Finally, we see that generalized trust has a positive impact on cooperation and moderates both forms of inequality, alleviating their effects.

Discussion

Our analysis brings support to the assertion that inequality has a corrosive effect on students' ability to learn collaborative problem-solving skills. Students who are exposed to a widening gap of wealth reduces their propensity to cooperate, which is an important component of a democratic culture. The finding parallels the negative effect socio-economic inequality has on other academic outcomes. In our study, we are able to show the negative relationship between inequality and science competency.

We also show that it is important how inequality is conceived and measured. Whereas most of its commonly used measures describe aspects of the entire society, we find that inequality inside certain groups matter, and can have strong effects on people's views and behaviors. Thus, one of the two types of inequalities that we investigate refers to the school context where the respondents learn, whereas the other describe differences among schools in terms of the mean wealth of parents. The stronger of the two effects is at the school level, suggesting that when inequality is experienced on a more intimate, its corrosive impact is greater. This finding further implies that societies could look stable from the point of view of Gini or similar measures, and, at the same time, could have a rapid growth of sub-national types of inequalities. The PISA instrument suggests that this is could be the case for many of the countries involved in the project since inequality among 15 years old increased in 75 percent of these countries since 2006.

Our analysis reinforces the notion that generalized trust is an attribute that contributes cooperative behavior. Our models show trust has a direct, positive effect. We also see that countries with low levels of trust are more vulnerable to the negative effects that inequality has on cooperation. Thus, generalized trust moderates the relationship. In this way, we speculate that the level of generalized trust impacts the quality of democratic governance.

We also assess the influence that political equality has on cooperation. We conceptualize political equality as an index capturing elements of transparency (openness), participation (accessibility), and representation (responsiveness) within the political system. Like generalized trust, we measure political equality on the national level. We find that where political equality is higher, student cooperation scores are also higher, suggesting that this aspect of democratic rule reinforces the reproduction of skills that contribute to the sustainability of democracy.

The moderating effect of political equality on cooperation resulting in a surprising finding. Low political equality mitigates the negative impact of inequality across schools on cooperation, as we expect. However, in countries with high political equality, we see cooperation rates higher where inequality across schools is higher. We know that among OECD countries, rising income gaps are observed in most cases with more families falling into the extremes of income distribution and fewer occupying a place in the middle. “Income inequality is less of a concern when children in low-income families have aa good chance of climbing up the income ladder when they grow up” (OECD 2017a, 174). From this perspective, countries with higher levels of political equality may be those where greater social mobility prevails. However, further analysis is needed before we can be sure of this optimistic interpretation.

Taken together, we see that generalized trust and political equality contribute positively to 15-year old students acquiring cooperation skills, and this is positive for democracy. However, many countries have deficits in both. Our findings serve as a warning sign that as this generation matures, fewer citizens with collaborative problem-solving skills will make it that much more difficult to sustain democracy. Indeed, we may be seeing signs of this already, for example in post-communist Europe where levels of inequality are increasing, but trust and political equality are in short supply. This could explain in part the increase of the illiberal tendencies among their youth.

At the same time, our research design has several limitations that should be addressed by future studies. Most importantly, we rely on cross-sectional data in order to infer causality and change over time, whereas longitudinal design would be more appropriate. Secondly, the links between the PISA measure of cooperation, based on online simulations, and cooperative behavior in real life situations needs to be assessed further for construct validity. Thirdly, when employing society-level variables, we recognize we have a relatively small size, with the sample itself being subject to selection bias as countries willing to participate in the PISA project. Thus, we must exercise caution regarding our inferences about aggregate citizen values and political systems. Finally, the analyses would benefit from having measures of trust at individual level, as well as more precise and diverse measures of inequality at mezzo level.

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